NEW SCREEN TECHNIQUES

26 illustrated articles by leading authorities on 3-D and wide screen films in production & exhibition

Edited by Martin Quigley, Jr.

New Screen Techniques

This book on "New Screen Techniques" deals primarily with three powerful new methods under commercial development in 1953 by the motion picture industry. They are *three-dimensional* or stereoscopic pictures; *wide screen pictures* and *stereophonic sound,* the distribution and location of which sound are both controlled.

It is interesting to note that these new methods are old in their origin and were thoroughly understood, in the main, decades ago. However, these methods have only recently been rather violently "sparked" into vigorous life by commendable pioneering demonstrations offered to the public.

These new methods cannot be expoited by adherences to old methods which were applicable to two-dimensional pictures, smaller pictures, or concentrated sources of sound. Similarly, these new art forms, if they are to reach their fruition and general acceptance, must be worked out correctly in detail and then broadly crystallized in their practices.

An ever-present danger in a new and rapidly changing art is a flood of wild rumors, half-truths, and undependable and sweeping statements. These should be avoided. In their place there should be a factual, judicial, and impartial presentation of all sides of the case. Certainly this present book meets the needs of those desiring such a presentation.

—From the Preface by
Dr. Alfred N. Goldsmith

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NEW SCREEN TECHNIQUES

Edited by Martin Quigley, Jr.

Illustrated

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Preface

DISTINGUISHED in the fields of motion pictures, radio and television as a scientist, engineer and inventor, Dr. Alfred N. Goldsmith is an authority well qualified to present the challenge of the new techniques. He is a past president of the Society of Motion Picture Engineers and of the Institute of Radio Engineers. He was a vice-president and general engineer for the Radio Corporation of America and for the past 20 years has had his own general consulting practice.

by Dr. Alfred N. Goldsmith

THIS BOOK on "New Screen Techniques" deals primarily with three powerful new methods now under commercial development by the motion picture industry. They are *three-dimensional* or stereoscopic pictures (3-D); *wide screen pictures,* having their width between about 1.60 and 3.00 times their height (W-S); and *stereophonic sound,* the distribution and location of which sound are both controlled (S-S). This book then is an up-to-date account of 3-D, W-S, and S-S.

It is interesting to note that these new methods are old in their origin and were thoroughly understood, in the main, decades ago. Well known were stereoscopic principles and methods as used in 3-D, the laterally extended screen of W-S, the anamorphotic-lens methods, used in W-S, wider-gauge film proposed for W-S projection, stereophonic sound, and other elements of the proposed changes in the cinematic art. However, these methods have only recently been rather violently "sparked" into vigorous life by commendable pioneering demonstrations offered to the public.

Stereophonic sound appears at this time to be capable of adding appreciably to the impact of W-S or 3-D showings. The addition of directed, distributed and mobile sound to the film programs, if skillfully accomplished, should substantially increase both the illusion of reality and the inducing of a desired mood. And these factors are the basis of the entertainment art.

As this book indicates, it is important that workers in these new fields should take them extremely seriously and should regard them not as novelties but as new and powerful entertainment types and art forms. Despite the long technical history of 3-D and W-S methods, they are quite novel in the field of showmanship and will really find their first extensive commercial use on the theatre screens in the coming years.

The successful introduction of 3-D, W-S, and S-S accordingly requires not only the skill of the producers but also the experience and ingenuity of the exhibitors. Theatres will necessarily be required to add equipment, to alter operations, and to resort to new forms of promotion, showmanship and exhibition. These needs are an exciting challenge to the exhibitor, offering him at once major responsibilities and rewarding opportunities.

These new methods cannot be fully exploited by adherence to old methods which were applicable to two-dimensional pictures, smaller pictures, or concentrated sources of sound. Perhaps the tasks of the motion picture industry would be easier if this were the case—but it is certain that considerable originality, experimentation, and inspiration will be required for the successful development of these new arts. Indeed, they will require careful selection, adaptation, and operation of each of the following factors, in many cases with coordination between all of these factors. The basic factors are the suitability of the original story, the nature of the continuity based on the story, the details of the shooting script, the design of the set, the lighting of the set, the nature and procedure of the sound pickup, the work of the directors, and the skill of the actors. Each of these factors will require substantial modification from former practices. And each of these factors will open new opportunities for more dramatic and exciting presentations.

Above all, crude and excess emphasis or misuse of the new techniques should be consistently avoided.

Only by taking this broad view of the nature of these new art forms 3-D, W-S, and S-S, can they be blended into so powerful a unity as to command public interest and support for decades or even for centuries. Long ago the legitimate stage developed its conventions and procedures most skillfully, and it has held public interest through the ages. Similarly these new entertainment forms, if they are to reach their fruition and general acceptance, must be worked out correctly in details and then broadly crystallized in their practices.

For a number of years the motion picture industry has been free from basic changes. Now such evolutionary modifications are clearly evident. Wisely guided and enthusiastically supported by all, they may win public acceptance and acclaim to the vast benefit of the industry. For this reason it is strongly to be hoped that advocates of any form of any of these processes will enthusiastically promote it, but will carefully avoid, however, any disparagement or depreciation of other methods. Constructive promotion without destructive criticism will avoid public confusion and dispute. Confusion might lead to a widespread loss of enthusiasm. And enthusiasm is always needed as a basis for the prosperity of the entertainment industry.

Another ever-present danger in a new and rapidly changing art is a flood of wild rumors, half-truths, and undependable and sweeping statements. These should be avoided. In their place there should be a factual, judicial and impartial presentation of all sides of the case. Certainly this book should meet the needs of those desiring such a presentation. Accordingly, the Quigley Publishing Company, having undertaken a most timely and helpful project, definitely deserves commendation and support from the industry of which it is a part.

August, 1953

New York, N. Y.

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Introduction

AS editor of Motion Picture Herald, Martin Quigley, Jr., must keep watch on all fields affecting the film for industry readers of the publication in 80 countries. He was among the first to urge extensive tests of the new screen techniques, and has written extensively on the origin and uses of 3-D and wide screens. He is the author of "Magic Shadows—The Story of the Origin of Motion Pictures," the standard work on the screen development from Adam to Edison, Paul and the Lumieres.

by Martin Quigley, Jr.

MOTION PICTURES in three dimensions and on wider screens are new steps in the realization of the age-old dream of developing the perfect story telling medium. Each method individually, and the two combined, seeks to reproduce before audiences dramatic situations in all their natural beauty and reality. This realizable goal is improved entertainment quality.

From an historical point of view both the so-called 3-D—stereoscopic films—and wide screen pictures are not new, dating back as they do to the earliest days of the art and industry. However, 3-D and wide screen pictures burst upon the American motion picture scene in the closing weeks of 1952 with all the suddenness of new-found comets. Each week, indeed, almost every day of 1953 was marked with an announcement of a new method, process or scheme.

Fundamentally, only one thing is involved: unshackling the screen from its traditional physical limitations. 3-D extends the range behind the screen and—when required for special effects—in front. 3-D also brings amazing life-like quality to screen images. Panoramic screens permit theatres to install the "big picture" within existing physical limitations.

Screens made in the old ratio established by Thomas A. Edison in 1888 in the proportion of 3 to 4 (i.e. three feet high to four feet in width) can not be increased in size beyond certain dimensions for any particular theatre. If an attempt should be made to do so it would be found that the screen height would become too great both for installation in the average theatre and also for the viewing comfort of spectators. Wide screens have been sought not only because they permit exhibition of larger pictures but also because such screens give motion pictures great dramatic effectiveness. Every other form of amusement—with the possible exception of the panorama of the circus—pales in physical comparison with a wide-screen theatre picture.

There is nothing incompatible—within reasonable limits—between 3-D stereo films and wide screens. 3-D films may be shown on screens in standard proportions or on wide screens. Conversely wide screens can exhibit any kind of picture.

A handmaiden of the developments in wide-screens and 3-D has been the swift progress in stereophonic sound. The method and means of imparting a directional character to sound are not new. Stereophonic sound with all its reality but without an accompanying motion picture was demonstrated in the Spring of 1940 by Bell Telephone Laboratories at Carnegie Hall, New York City. The similar RCA system had its premiere with Walt Disney's "Fantasia" late in the same year. At that time there appeared little general interest in stereophonic sound. Only a dozen installations were made of the special equipment required. Exhibitors concluded that the effects produced were not worth the cost and installation difficulties involved.

The public apparently noticed little difference in the sound effect. This was true, at least partially, because "Fantasia" was shown on a standard size screen. Having sound come from the left, center and right portions of a standard screen in synchronization with the action of the characters did not materially increase the effectiveness of the performances. On the other hand, wide screens and very wide screens require stereophonic sound to impart a life-like quality.

Despite the showmanship characteristic of the industry and its leaders, the motion picture has ever been conservative. Major innovations have sometimes been thrust upon it from without. That was true of the addition of sound. It is true again with 3-D, wide screen and stereophonic sound.

The new age of the motion picture may be properly dated from the opening of Cinerama in New York on September 30, 1952. Here was a device previously demonstrated to the leaders of the industry. Most observers liked it but viewed its complexity with disfavor and feared that the public would not be sufficiently interested to compensate for the installation and operating cost. It was clear after the opening that the public was exceedingly interested. From that first night of Cinerama there was a pursuit, indeed a scramble, in Hollywood for wide screen devices and methods. The discovery of a "poor man's Cinerama" became a major goal.

Equally as significant as Cinerama's opening was the premiere of Arch Oboler's "Bwana Devil" on November 27, 1952 in Los Angeles. This film, made with the Natural Vision Corporation's 3-D camera, was an independent effort. Milton Gunzburg, president of Natural Vision Corporation, had pleaded in vain with the principal Hollywood studios to make a feature in the process. Notwithstanding manifest defects in "Bwana Devil" the public's enthusiastic response opened the way to a flood of 3-D films. Every production in 3-D released since then has been marked by some improvement in the use of this new technique. Hollywood's technicians have proved many times in the past their skills in bettering technical devices.

While 3-D short subjects in the so-called "anaglyph" method (involving the use of red and green viewers) had some success in the 1920s and 1930s, the prevailing dictum until 1953 was "the public will not wear glasses." This attitude persisted even following successful exhibitions of commercially-sponsored 3-D films made in 1939 in the anaglyph method and in 1940 in the Polaroid system. Before 1953 ended many millions of the public in the United States, Canada and throughout the world wore polarizing glasses in order to view theatrical motion pictures. Whether the public will continue to wear glasses is a matter of speculation. The best presumption is that the public will continue to use glasses as long as the 3-D productions are worth seeing and the effects produced are superior or pleasingly different from those obtained in other screen entertainments.

So far as theatrical motion pictures are concerned true 3-D illusions require the projection of an image for the left eye and an image for the right eye and the separation of these two images by some type of viewer. The fusion takes place only in the mind, which "sees" the pictures in depth. Experimental processes of 3-D without glasses involve other means of separating the images such as a grid system in front of the screen. All devices of this kind limit the number and viewing locations of the spectators so that they are impractical for theatres.

Although 3-D films can be shown on wider screens than the traditional standard size, it is unlikely that they will be found to be suitable for the very wide panoramic screens, which open up an entirely new vista for motion picture entertainment.

Panoramic screens, including Cinerama, CinemaScope and others, impart to the spectator a greater sense of participation in the action depicted than was previously possible. In fact with Cinerama—which achieves the greatest audience participation of any system—the spectator's feeling of being within the action is real to an astonishing degree. The Cinerama screen partially engulfs the audience. CinemaScope, on the other hand, aims more at spreading before the audience a great canvas of action and also a more dramatic sense of reality in medium and closeup shots than standard practices permit.

Wide screen pictures may be obtained in five ways: by cropping the top and bottom of standard pictures and projecting the resultant film on a wide screen surface; by using a film wider than the standard 35mm; by using very wide angle lenses; by compressing the image horizontally and expanding it in the same meridian on projection; and by using a battery of camera and projectors, each handling a part of the over-all scene. All these methods were used for feature production tests in Hollywood in 1953.

* * * * *

In this book is offered an authoritative presentation by experts of the major factors of 3-D, wide screen and stereophonic sound from the production and exhibition points of view. Sufficient technical theory is included so that the reader may understand the principles and problems of 3-D and wide screens. Diagrams and charts are used where helpful. Although some of the theory is necessarily complex, it is presented in language for the layman.

As it is impossible to understand the present or chart the future without reference to the past, a certain amount of historical material also is included.

For the convenience of the reader the articles on New Screen Techniques have been arranged in two parts: Part One deals generally with 3-D stereo pictures and Part Two with wide screen systems of various kinds. However, the division is not absolute as the new techniques may be applied to all kinds of films. Some of the articles have equal bearing on 3-D and wide screen activities. For example, stereophonic sound is treated in one article in the 3-D part of the book and in three articles in the Wide Screen part. Yet the principles of stereophonic sound and its application are substantially the same no matter where used.

An evaluation of the comparative merits of the various methods and systems is left to the reader, and to the theatre-going public.

* * * * *

The editor is deeply appreciative of the participation of the distinguished contributors to this volume, each of whom generously found time to contribute to this undertaking while in the midst of advancing actively in his own field of interest the new techniques of the screen. That they have done so is a tribute to their belief that the public and the industry should well understand the theory and practice of these latest developments in the art and science of the screen.

In addition to this expression of thanks to the contributors to this book, individually and collectively, the editor wishes to record an expression of gratitude for helpful assistance and advice in the production of this volume to Dr. Alfred N. Goldsmith, Charles Einfeld, Lynn Farnol and Mort Blumenstock (also contributors); to Maurice Bergman, Universal Pictures; Charles Cohen, 20th Century-Fox; Louis A. Bonn, William German Company; Charles S. Aaronson, editor of *The Motion Picture and Television Almanac;* and James D. Ivers, editor of *Fame.*

* * * * *

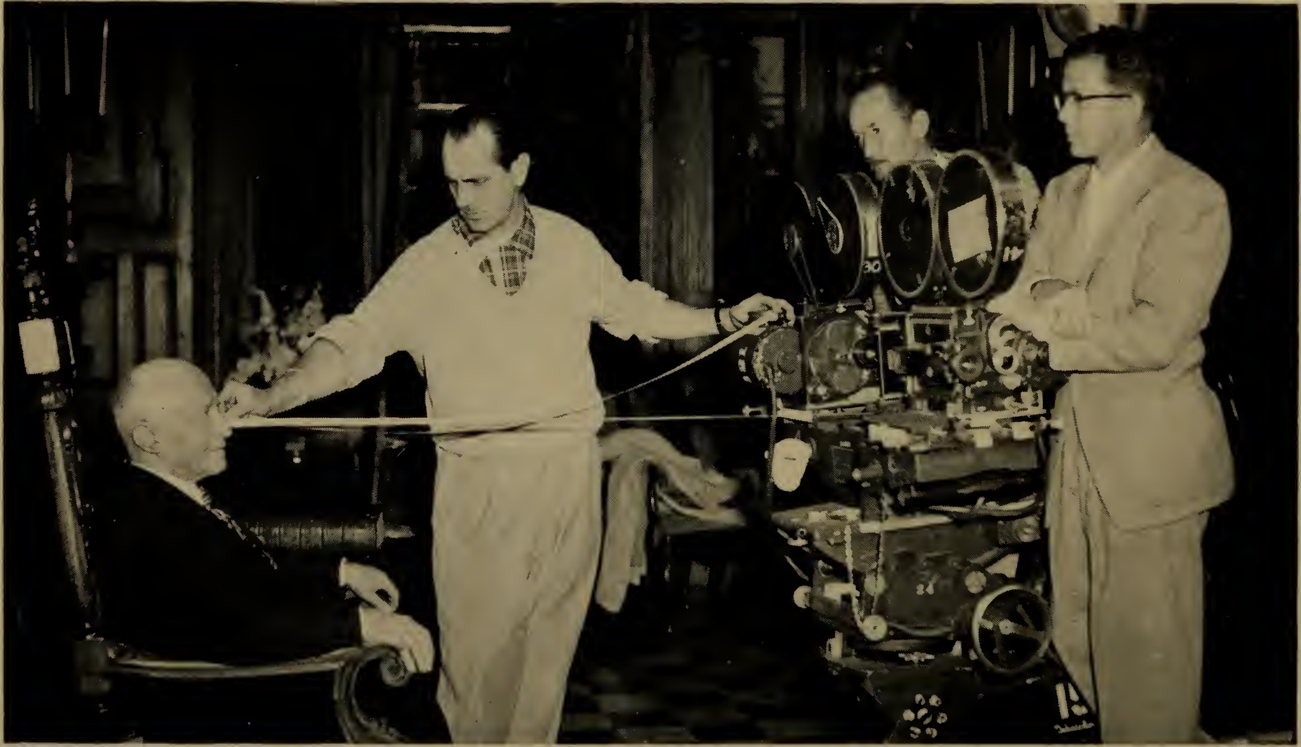
Excitement over the "NEW SCREEN TECHNIQUES," spreading as it has to the public at home and abroad, is an auspicious beginning for the second half-century of the entertainment motion pictures. First pictures released in the new techniques, as impressive as they have been, only suggest the great dramatic power and sweep of the film when the technical wizards of Hollywood and other screen capitals throughout the world learn how to use these new tools most effectively. The screen has been freed. No longer is it bounded by an arbitrary rule. It has gained depth and scope.

Most important, perhaps, of all, the industry throughout the world is experiencing with the coming of the new techniques a confident enthusiasm that seems destined to result in better and greater entertainment upon the theatre screen.

PART I

Three Dimension Motion Pictures

- Production
- Exhibition
- Exploitation



ADOLPH ZUKOR, chairman of the board of Paramount Pictures, an enthusiastic advocate of new screen methods, is photographed for the trailer of "Sangaree", the company's first 3-D feature.

Three Dimensionally Speaking

WITH a voice and personality known and loved throughout the world Pete Smith as commentator for his MGM short subjects for a quarter of a century has made hundreds of millions laugh while the same time pointing up information worth remembering. For the past ten consecutive years exhibitors have voted Pete Smith Specialties the No. 1 live action short subject series in the Motion Picture Herald-Fame polls to determine box office winners.

by Pete Smith

1-D; 2-D; 3-D and Forsooth!
My, my, such carrying on!!

WELL, BEAR WITH ME a few moments while I remove my Memory Book from the library shelf for a bit of reminiscing.

Turning the pages I find that in the early part of 1936 MGM introduced something so new, so startling, that audiences throughout the country could hardly retain their seats when they saw it. Upon entering the theatre they had been given a pair of celluloid glasses with red and green lenses, with the admonition not to throw them away. After draping themselves in the plush seats the patrons were suddenly stirred from their placidity by objects that seemed to jump out of the screen and right into their laps as the tenuous tenor of your scribe boomed from the far reaches of the sound track. Here was a brand new thrill, a complete change in the presentation of motion pictures.

Thus was born to motion picture theatre audiences their first introduction to "Audioscopiks," the film that added a third dimension, depth, to the customary film in two dimensions. Men gasped, women shrieked. And little children bounded about deliriously. They ducked baseballs and splashing water. They hid from a mouse that boldly approached them. They shrank from a torch which was seemingly thrust in their faces. They rode in a roller coaster. All this was the audience reaction to three-dimensional photography which now may portend a momentous change in the motion picture world. But how did it all start? Here's the story.

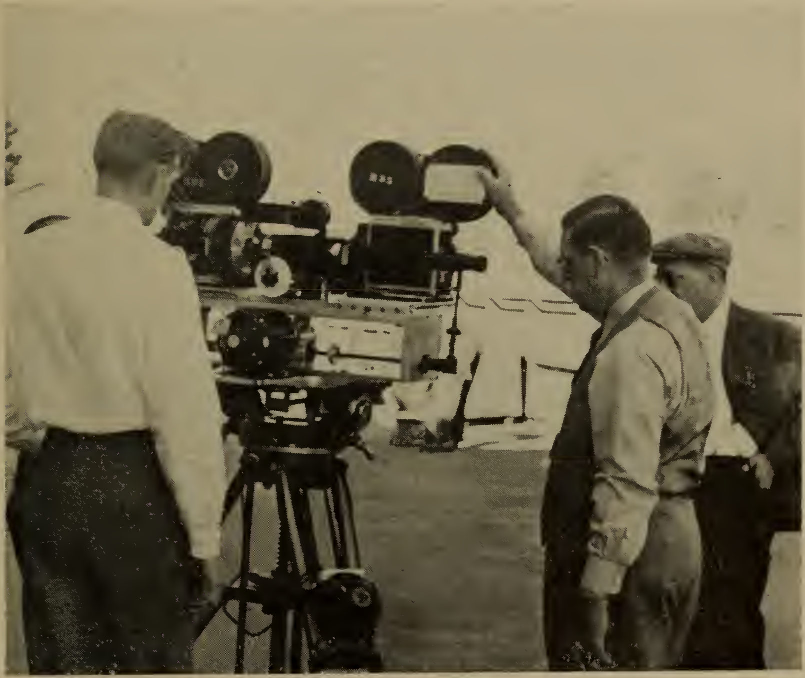
Fred Quimby, head of the MGM Short Subjects Department, had arranged for the purchase of some footage which was photographed by J. F. Leventhal and J. A. Norling. Said footage was turned over to me for editing and sound treatment and narration and it became a Pete Smith subject titled "Audioscopiks." Later additional footage was purchased and resulted in a second release called "New Audioscopiks." Pardon my immodesty, but the Sales Department assured me that these pictures played to maximum bookings throughout the world. As the result of such success, we at MGM decided to enter the 3-D field.

Believe me when I tell you we started from scratch. We knew nothing about the technical phases involved so I consulted J. M. Nickolaus, who thought it could be done by exercising "photographic common sense" to use his own phrase. He went to Studio Manager E. J. Mannix and expressed himself accordingly. Mannix asked Nickolaus what the cost would be for camera conversion.

The answer was, "About $3,000." Mannix gave Nickolaus the go-ahead signal for the research program. After a certain amount of trial and error, Nickolaus came through with the desired results. He used two regular Bell & Howell cameras with specially matched lenses made by Bausch & Lomb. The lenses were 2¾ inches apart and were shot into prisms. Technical associates with Nickolaus on this project were Irving Ries and A. G. Wise. All of the experimental work was very hush-hush. The trio and I, together with Director George Sidney, worked in a basement on the studio back lot. Talk about a restricted area—this was IT!!

When the tests proved happily successful, we started on our script, a travesty on the Frankenstein craze of that era. Unlike the first two subjects which were a series of clips, our picture told a complete story. Instead of "Audioscopiks" we called our process "Metroscopix"—so named by the prolific Howard Dietz. The title of the picture was "Three Dimension Murder." So intrigued were the millions who saw this subject that it became necessary to explain the whys and wherefores. We did it thusly!

The comparison of the camera to the human eye has often been drawn. But it seems the average human has not one, but two eyes. By looking down upon a small object held a few inches from a table, and closing one eye, it will be noted that the object appears to be on a plane with the table. When looking through the other eye, the object still appears to be on a plane with the



***AT MGM STUDIOS** in 1937 Cameramen B. C. Parker and Jack Smith and the late Kyne Meade inspect the 3-D camera made by John Nickolaus for Pete Smith's "Three Dimension Murder", anaglyph short subject.*

table, but a slightly different view of the object is seen. When both eyes are opened the picture seen by each is fused in the brain and not only is length and width noted, but also its depth.

Therefore, in bringing three dimensions to the screen, two cameras are used, one representing the right eye, the other the left. With the two cameras placed a distance apart proportionate to the space between two eyes, a picture is taken.

Then the film in both cameras is developed. The film taken by the camera representing the left eye is dyed red and that taken by the "right eye" camera is dyed green.

The films are then placed one on top of the other and if the double film is held up to the light, two slightly different views of the same picture can be seen.

But, why is the "left eye" camera film dyed red and the "right eye" film dyed green? Well, it seems that photography, not being human, has no brain to fuse the two pictures together. Therefore, glasses are used, having one red lense which must cover the right and one green lens which must cover the left eye.

Then the film is flashed on the screen and the glasses are properly placed over the eyes, the green lens in front of the left eye filters out the green film on the screen; the red lens in front of the right eye filters out the red film on the screen. Therefore, the left eye sees only the red film, or what the "left eye camera saw," the right eye sees only the green.

With each eye seeing only that portion which it sees in normal vision, that same convergence of the eyes, noted in ordinary sight takes place and the brain fuses the two pictures together—again creating the impression of depth.

Incidentally, the three 3-D pictures to which I refer and their respective release dates were "Audioscopiks" (January 11, 1936); "The New Audioscopiks" (January 15, 1938); and "Third Dimension Murder" (March 1, 1941).

Polaroid and 3-D Films

AS a research engineer in three-dimensional photography for the Polaroid Corporation since 1940, William H. Ryan has been closely associated with the development of commercially practicable 3-D motion pictures. Prior to the invention of a satisfactory polarizer by Dr. Edwin H. Land stereo pictures were confined to the "anaglyph" system with its serious limitations. In this article Mr. Ryan explains how the modern 3-D movie viewing system works.

by William H. Ryan

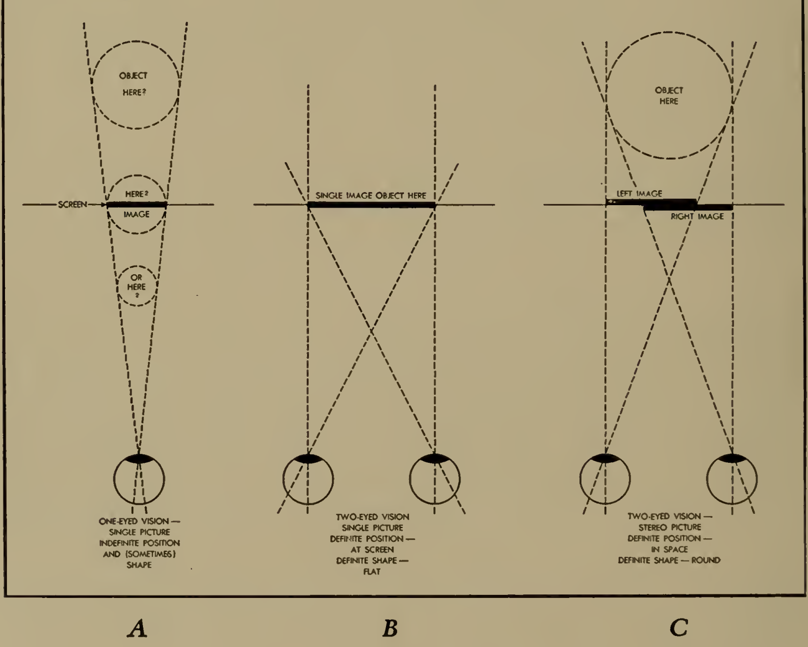
IN THESE VIGOROUS, exciting times of rapid evolution—and revolution—of the motion picture, the greatest technical advances since the introduction of sound and color are being made in the theatre. All of them are aimed at the enhancement of realism, by adding more information for the senses of vision and hearing. Whether in "wide-screen' or "stereo," (though the two are by no means mutually exclusive) the integration of a satisfactory illusion of three-dimensionality into theatrical projection must provide some of the same stimuli which produce this illusion in normal visual processes.

ESSENTIALS OF PERCEPTION

Binocular human vision is the complete natural synthesis of all the means the eye and the mind employ to determine the depth, roundness, separation, distance, texture and other attributes of objects in visual space. Many of these clues to the nature of perceived space can be detected using only one eye. One-eyed persons can often develop a sharp sense of depth relationships. For this reason it is often thought that, with the addition of other depth clues (by motional parallax and other means), the presentation of an essentially one-eyed view on a theatre screen can be made to achieve a convincing three-dimensional effect.

In a monocular view of the world about us, the depth is actually indefinite, and the observer then interprets the view he sees as lying in different planes according to his experience, as illustrated in Fig. 1A. However, when a picture is projected

FIG I.


OBJECT HERE?
HERE?
SCREEN
IMAGE
OR HERE ?
ONE-EYED VISION — SINGLE PICTURE INDEFINITE POSITION AND (SOMETIMES) SHAPE
SINGLE IMAGE OBJECT HERE
TWO-EYED VISION SINGLE PICTURE DEFINITE POSITION — AT SCREEN DEFINITE SHAPE — FLAT
OBJECT HERE
LEFT IMAGE
RIGHT IMAGE
TWO-EYED VISION — STEREO PICTURE DEFINITE POSITION — IN SPACE DEFINITE SHAPE — ROUND
A
B
C

IN one-eyed vision (above left), the brain may interpret a single image as a large object far away or a small object nearby. In two-eyed vision, the object is fixed in direction, size, shape and distance, whether the image is flat (center) or stereoscopic (right).

upon a *surface* (the theatre screen), and viewed with *both* eyes, a truly three-dimensional sensation will not be obtained, although the picture may otherwise be very enjoyable, not necessarily due to the lack of positive evidence of depth, but due to the presence of *"negative" depth clues.* The similarity of convergence angles for all parts of the image, whether pictorially "near" or "far," tells the observer definitely that the picture is really a surface. (Fig. 1B) In order to have depth "without glasses," therefore, it would first be necessary to remove the evidence of the planar character of the projection screen. This has not proved feasible, whether the screen is actually plane or curved.

A single projected picture, looked at with both eyes, will always have some characteristics by which the eyes can tell that the flat surface on which it is projected actually exists, although the content of the picture itself may be giving a different impression. In the stereoscopic picture, this problem does not occur, as both eyes do not see the same picture. In addition, the parallax differences and other positive depth clues enforce the mental conclusion that depth exists as in nature (Fig. 1C).

In a true stereo system, two pictures are taken from different viewpoints representing the left- and right-eye positions of a human observer. As we shall see later, relationships of the camera elements should not correspond too literally to human anatomy, but should instead agree with the requirements dictated by the *situation in the theatre* so that the observer gets the most realistic view.

The next step is the presentation of these two views in the theatre to bring the left-eye view to the spectator's left eye and the right-eye view to his right eye. To do this involves some manipulation of the light forming the images on the screen.

Methods of Stereo Projection

A ray of light has four fundamental properties which can be operated upon to isolate the right- and left-eye images: time or duration of its existence, direction in which it is traveling, frequency at which it is vibrating, and direction of vibration.

The first property can be used for stereo projection by timing the sequence of left and right images to agree with the opening and closing of optical paths to the eyes, as in the "eclipse" system, which uses synchronized alternating shutters on the projectors and at the eyes.

The second property is the basis of the "parallax stereogram" systems of projection, which take advantage of the fact that light travels in straight lines, and use grids or lenses directly in front of the screen.

The third property, frequency, determines the color of the light; by employing different portions of the spectrum for the left and right pictures, and selective filters passing them at the eyes, the well-known "anaglyph" is achieved.

The fourth property, direction of vibration, can be determined and selected by light polarizers, and forms the basis of nearly all the commercial stereo projection systems today. A basic reason why this is so is that of all the properties of visible light, polarization is the only one that can not be detected in some way by the unaided eye. Thus, when other properties are used to obtain stereo effects, some part of the light which is normally necessary to the perfection of visual images of natural objects is lost, and manifests itself in flicker, loss of color, loss of definition, or loss of tone scale.

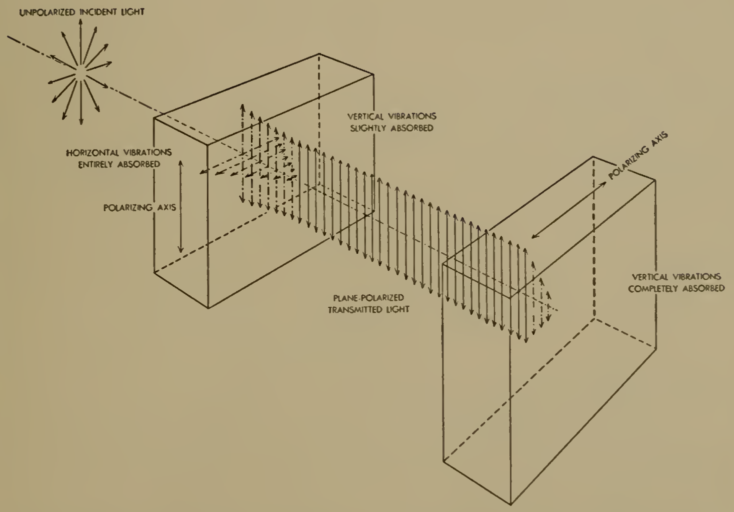
In polarized light systems, the only "inherent" loss is one of efficiency occasioned by the division of the incident light into the "parallel" and "crossed" components; but even this loss would not be necessary if sources of pre-polarized light were developed commercially, or if each component of an unpolarized beam were used to form a useful picture, as in the Polaroid Vectograph described below.

The operation of a light polarizer is shown schematically in Fig. 2. A beam of unpolarized light, consisting of rays vibrating in all directions perpendicularly to the direction of travel of the beam, upon entering a polarizer is resolved into two components polarized at right angles to each other. As the beam passes through the polarizer, one of these components is gradually absorbed. The other is passed essentially without change. All the light transmitted is therefore vibrating in the same direction. This direction is called the polarizing axis of the Polaroid film. If in the path of this beam a second polarizer is placed, with its axis parallel to the first, the beam is again passed through without change. But if the second polarizer is placed with its axis at 90 degrees to the first, the beam will be absorbed. Thus the second polarizer acts as a "go" or "no-go" valve for light passed by the first polarizer. It is easy to see, then, by using, a pair of such "valves" before the eyes at 90 degrees to each other, and polarizing each stereo picture in the corresponding way at the projector, that the system will allow each eye to receive only the picture intended for it.

STEREO PROJECTION WITH POLARIZED LIGHT

In the present theatre stereo system, the light beams from the pair of synchronized motion picture projectors showing the left- and right-eye films are intercepted by polarizing filters, with their polarizing axes at right angles; viewers with a correspondingly oriented filter for each eye are worn by the spectator (Fig. 3). An upright V relation of the polarizing axes —the axis of the left eye filter sloping down to the right, and

FIG 2.

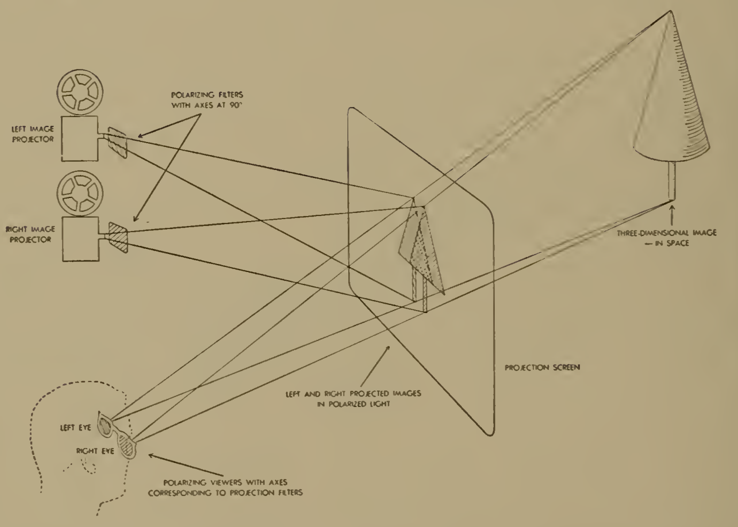

UNPOLARIZED INCIDENT LIGHT
HORIZONTAL VIBRATIONS ENTIRELY ABSORBED
POLARIZING AXIS
VERTICAL VIBRATIONS SLIGHTLY ABSORBED
PLANE-POLARIZED TRANSMITTED LIGHT
POLARIZING AXIS
VERTICAL VIBRATIONS COMPLETELY ABSORBED

POLARIZED light produced by one polarizer is absorbed by a second polarizer oriented at 90°.

the axis of the right eye filter sloping down to the left—has been chosen, rather than a horizontal-vertical relation. This is to eliminate any possibility of the spectator accidentally getting a "pseudo-stereo" picture—the left picture seen by the right eye, and vice versa. For example, if in the darkened theatre the temples of the viewer are folded in the wrong direction, the view through the back of the filters will still be correct. Polarized reflections from stage and floor will also be of equal brightness in both eyes. This convention works well in the orientation of a Vectograph transparency, which can be viewed from either side without losing proper stereo.

The viewers consist of thin polarizing films mounted in simple spectacle-type cardboard frames. These viewers were designed to be used only once, since years of experience have indicated that, entirely aside from the health problem, there are optical and aesthetic reasons for not re-using viewers of

FIG 3.


POLARIZING FILTERS WITH AXES AT 90°
LEFT IMAGE PROJECTOR
RIGHT IMAGE PROJECTOR
THREE-DIMENSIONAL IMAGE — IN SPACE
PROJECTION SCREEN
LEFT AND RIGHT PROJECTED IMAGES IN POLARIZED LIGHT
LEFT EYE
RIGHT EYE
POLARIZING VIEWERS WITH AXES CORRESPONDING TO PROJECTION FILTERS

LEFT and right eye stereo images, projected through polarizing filters at 90° to each other and seen through corresponding polarizing viewers, appear as a single three-dimensional image in space.

this type. Fingerprints, scratches, and hair and skin oils frequently accumulate on viewers, impairing the clarity of the view through the filters and making them less acceptable.

Projection filters for the theatre stereo system are made of a highly heat-resistant Polaroid film, originally developed for surfaces of automobile headlight lamps, where exceptional durability and high efficiency are prime requirements. This material, laminated in optically flat glass, withstands the heat of the projector beam very satisfactorily.

The projection screen is an important element of the total system. In addition to its usual qualities, it must also reflect the polarized light beams from the projectors without either depolarizing them or changing the axis of polarization. Metallic surfaces can do this, but tend, like a mirror, to concentrate the light in one direction of reflection. A number of screen manufacturers have now succeeded in preserving the polarization effects while spreading the reflected light over an adequately wide angle.

The tremendous advantage of polarization in stereo projection lies in its easy adaptation to either still or motion picture equipment, without any change in the quality of the picture. It is, moreover, the only practical system by which color films can be projected.

The principles of stereo projection by polarized light were apparently first proposed by J. Anderson in England in 1891. Although Herapath had made the first synthetic polarizing plate in 1852, it is significant that early experimental embodiments of the Anderson method used Nicol polarizing prisms or other cumbersome polarizers. The Herapath plates (made of a single crystal of iodo-quinine sulfate carefully grown to maximum size) were still so small, fragile and difficult to make that no commercial success was possible.

In 1928, when Edwin H. Land filed his first patent application on a sheet polarizer, the polarized-light system of stereo projection first became really practical. This was, in fact, one of the principal uses the inventor had in mind for his material from the beginning. Land's polarizer consisted of a flexible plastic film which could be easily cut, shaped and laminated for the manufacture of filters and viewers, and, as is now being so amply demonstrated, could be made in large sizes and almost unlimited quantity. Land's first commercial polarizer, unlike those of Herapath (and later Marks and Bernauer), did not depend on the slow rate of crystal growth to achieve size and quantity. In this Polaroid film, needle-shaped crystals of sub-microscopic size were formed in great numbers, and oriented uniformly in a plastic sheet. Each needle is a complete light polarizer and the alignment of the needles is very uniform. As a result, the overall polarization can be controlled in manufacture within very close limits.

Concurrently with the development of the polarizer, Land and his associates undertook the development of several of its most important commercial applications, including stereo projection. Several methods, double-camera and double-projector, beamsplitter, alternate-frame, lenticular and others were tried.

Kodacolor film, 16mm lenticular material, had just been put on the market and the earliest films made by Land and George Wheelwright III combined full color, motion and three-dimensions—the first such pictures in photographic history. (Their first laboratory being a rural dairy building with few technical facilities, these films were developed, by an intricate reversal process, by Wheelwright while locked in the icebox, the only darkroom available!) These motion pictures were taken with two synchronized cameras and projected in synchronized projectors, essentially the same as in today's theatrical system.

A later stereo motion picture made in a standard camera equipped with a beamsplitter of Land's design and projected in a standard projector equipped with the same device, was demonstrated at the convention of the Society of Motion Picture Engineers at Washington, D. C., in 1935. This novel beamsplitter divides the field of a lens without dividing its aperture, thereby conserving all the light. A film of this type was donated to the Museum of Science and Industry at Rockefeller Center, New York, where, beginning in 1936, it was shown several times daily to many thousands of visitors over the next several years.

The New York World's Fair of 1939-40, a showcase for the latest achievements of art and technology, offered a special opportunity. It was possible then, under excellent sponsorship and with a budget large enough to provide a first quality production, to test the public reaction to stereoscopic motion pictures on a larger scale. Under the experienced hand of John A. Norling, the Loucks and Norling Studios produced a motion picture for the Chrysler Corporation exhibit, which was shown by the Polaroid system during the Fair and in later roadshows to about five million persons. A double-projector arrangement similar to the present method of theatrical projection was used. Audience reaction to this, as to the Museum of Science and Industry show, was overwhelmingly enthusiastic.

From 1936 on, as each important new improvement emerged from the laboratory, Land brought the possibilities of theatrical stereo to the attention of the motion picture industry. But in the late 1930s, the problems of readjustment after the Depression made radical innovation somewhat difficult, and in the early 1940s, the transition to the war economy not only preempted materials but also turned the attention of everyone to military development.

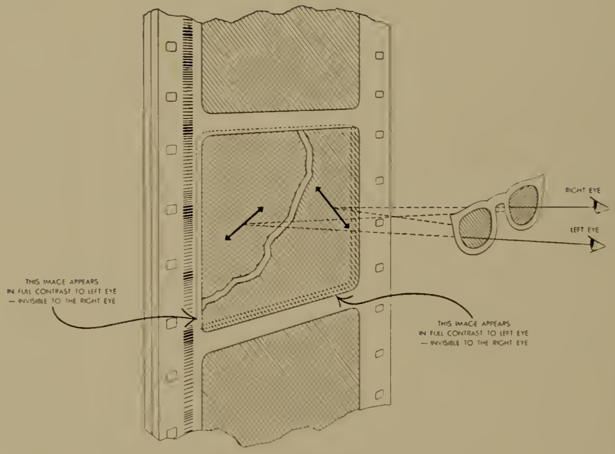
During this period two new products of great importance to the motion picture were announced by Polaroid. The first was a new kind of polarizer in which the sheet plastic material itself did the work of polarizing the light, without benefit of crystals. This polarizer, now used for stereo viewers, provides high transmission of the wanted component while maintaining almost complete (99.97%, on the average) extinction of the unwanted component, with excellent neutral color. Its fine optical properties have also contributed to its acceptance for varied scientific uses.

A further new development was the Vectograph, invented by Dr. Land in association with Joseph Mahler. Formerly in stereo systems, pictures and polarizers were separate sheet materials, each picture requiring a polarizer to achieve the projection and viewing of the stereo image in polarized light. In the Vectograph, the polarizer *is* the picture, and two of them, with polarizing axes at right angles, may be superimposed on a single film support to form a self-contained stereograph which needs only the viewing spectacles to complete the three-dimensional effect (Fig. 4). Since all the stereo-image functions are performed by the Vectograph itself, only one projector of the ordinary type is needed, without any changes or attachments whatsoever.

Polaroid's announcement of the Vectograph to the scientific world was made at the annual meeting of the Optical Society of America in 1940. Soon after this, the U.S. Armed Services, recognizing the value and simplicity of the Vectograph for many military and technical uses, principally aerial photographic interpretation, procured large quantities of the materials for making still pictures for use in all areas of the war. Great Britain also used substantial quantities.

Another military development by Polaroid in the early part of World War II deserves note. The Polaroid Machine Gun Trainer synthesized the optical, acoustical and mechanical sensations of anti-aircraft gunnery, so that thousands of trainees were given experience under conditions very close to the real thing. A battery of projectors threw stereoscopic tracer bullet

FIG 4.


RIGHT EYE
LEFT EYE
THIS IMAGE APPEARS
IN FULL CONTRAST TO LEFT EYE
— INVISIBLE TO THE RIGHT EYE
THIS IMAGE APPEARS
IN FULL CONTRAST TO LEFT EYE
— INVISIBLE TO THE RIGHT EYE

VECTOGRAPH film is a complete, self-contained stereo material, which may be viewed directly or projected in a standard projector with no attachments.

images, in an exact reproduction of the real trajectory, on a screen showing a three-dimensional motion picture of attacking aircraft. One hundred and ten of these units were manufactured for the Services, together capable of "firing" 5,000,000 rounds of ammunition a day.

For this and other training devices, Polaroid soon undertook the development of its Vectograph process in motion picture form. Although the end of the war occurred during the development period, several reels of Vectograph films were produced, on facilities rented by Polaroid at the Cinecolor plant.

Some Special Problems in Theatre Stereo Projection

Unlike pictures for the stereoscope, pictures for stereo projection must be specially taken for maximum effectiveness. Realizing this some twelve years ago, the author with others in Polaroid's Research Department began the study of several fundamental aspects of stereoscopic vision and photography, for the purpose of obtaining optimum conditions for really large-screen stereo projection. It was apparent that absolute reproduction of visual space for all object distances was not possible. In normal vision, the point of common interest and attention for the two eyes is that point at which the eyes are both converged and accommodated (focused). In reproducing natural space relationships in the stereograph, this cooperation of convergence and accommodation cannot always occur, as the accommodation is necessarily fixed on the screen while the convergence must change according to the apparent distance of the object from the observer. Extremely near positions require, in a large theatre, a substantial departure from the normal habits of convergence and accommodation, and some people do not have the knack of making this adjustment. Several possibilities for overcoming this difficulty exist, each involving some compromise with the exact reproduction of reality. The principal center of interest in the two pictures may be superimposed, substantially eliminating the difference from the normal convergence-accommodation relation so far as the center of interest is concerned. However, rigid adherence to this technique does not allow for those situations where the object should, for artistic reasons, lie well behind or forward of the plane of the screen, and no special provision is made for the correct interpretation of shape and size.

A second proposal is to photograph a closeup so that it will appear like a real, large object, with depth in correct proportion to its projected width and height, at or near the plane of the screen. This possibility, suggested by Professor J. T. Rule of M.I.T. in 1941, was tested in detail through the generous cooperation of several of the country's best color photographers in association with Polaroid Corporation, Professor Clarence Kennedy of Smith College and the Eastman Kodak Company. These stereo photographs, while undoubtedly some of the finest ever taken, and extremely effective for distant views and medium shots, were not uniformly successful; close objects lacked sufficient roundness, whereas, in the preceding technique, they usually appeared excessively deep.

The closeup problem was then studied at Polaroid in detail by empirical methods to determine the effect on large-screen projection of the several variable factors, such as camera-lens focal length, lens separation, etc. This study led to two general conclusions. First, happily, that many of the standard practices of two-dimensional photography, such as the use of longer focal length lenses to reduce distortion, worked equally well in practice in large-screen stereo. Second, if the accommodation-convergence relation of such pictures is kept within certain viewing limits, the stereoscopic result will satisfy most of the aesthetic requirements. The limits are an expression of the departures from the normal convergence-accommodation relation which practically all persons tested could make without conscious effort, with complete comfort and full appreciation of the stereo effect.

The factors involved in adjusting the camera according to these precepts have been reduced to their mathematical relationships and arranged on a calculator. The "comfortable limits" defining some of the factors vary, of course, from one situation to another, and are re-evaluated in the light of new information coming from the production of the current 3-D films as screen sizes and other elements change. The overall definition of the picture system, heretofore considered only in its physical implications (the "resolution" of the geometric space), apparently has a great deal to do with the tolerable convergence-accommodation ratios and the shape-size distortion problems. Work on this project continues toward developing a unified theory that satisfactorily explains all the observed practical results.

Dr. Land, whose inventions made this new dimension in the theatre possible, predicts that it will be welcomed eventually as an artistic instrument of the greatest importance. "To conceive of the motion picture as a painting, in motion," he says, "leads to one kind of aesthetic policy; to conceive of it as a flexible, readily changeable version of the living stage leads to an entirely different one. The champions of the first point of view would believe that stereo is too much, just as in the past they thought that color, and sound were too much. But the evidence is that after each of these advances in realism is accomplished and technically perfected, we all prefer the greater realism.

"One important qualification, however, must be added: to intrude too obviously on the real world of the *auditorium* can detract from our ability to enjoy vicariously the world of the motion picture as it unfolds on the *screen*. Those who voice a general objection to the heightened realism of stereo may well be protesting against the violation of this proper boundary. Our great goal should be to make movies as real as life around us, but this reality should be confined to the 'other side' of the proscenium. The greater the technological perfection of this other world, the more wholly we can identify ourselves with it —while safely outside."

In keeping with the spectacular traditions of the motion picture, giant strides in technology and artistic technique have been made in a short period. There is every assurance that, within the very near future, perfect enjoyment and comfort for the audience, convenience for the exhibitors and the maximum scope for the imagination of the producers will be achieved.

Basic Principles of 3-D Photography and Projection

WITH a record of two decades of pioneer work, John A. Norling has made many important contributions to the development of 3-D pictures. In association with J. F. Leventhal, he made the early "anaglyphs" released in the 1930s by MGM. In 1939 he made the first 3-D Technicolor film using Polaroid viewers. He has developed a 3-D camera of efficient and compact design. He is president of Loucks & Norling Studios, Inc.

by John A. Norling

ALTHOUGH MAN is a two-eyed being he can get along with one eye and get along very well. But the one-eyed view of the world is very different from the two-eyed binocular view.

The sensations received by the eyes are transmitted to the brain, where, in a psychic assembly room, the two dissimilar images are fused together so that we become conscious of depth in the view.

One reason the eyes receive slightly dissimilar views is that they are spaced some distance apart. The right eye sees a little more of the right side of an object than the left eye, which sees a little more of the left side.

The 3-D camera copies the arrangement of the eyes in that it contains lenses spaced some distance apart. What this lens spacing should be for a given object distance will be discussed later, as well as the reasons for not retaining a fixed spacing, such as the human eyes have, will also be given.

PLANAR AND 3-D PHOTOGRAPHY

Planar (two-dimensional) photography gives pictures having only height and width. The one-eyed view of the planar photograph prevents our ever mistaking the view of an object for the object itself.

Three-dimensional photography gives pictures which have depth as well as height and width. They have space in them. They have the impact of reality. Shown in motion and in full color, 3-D pictures carry naturalness to a point where the illusion is substantially complete and observers are likely to lose all sense of looking at pictures, provided the 3-D presentations do not contain depth distortions and exhibit other technical faults.

NEED FOR EQUAL IMAGE SIZE

One thing is very important: The two images in 3-D photography must be of the same size. There is an eye disorder called "aniseikonia" and sufferers therefrom have difficulty in fusing the images because one forms an image differing in size or shape from that formed by the other eye. Good binocular vision depends, among other things, on "matched" eyes, eyes that produce two images of the same size and shape.

Good 3-D photography depends, among other things, on using lenses which are closely matched in focal length. If they are not closely matched the 3-D camera can be said to have "aniseikonia." This applies also to projectors with unmatched lenses. Projected 3-D pictures differing in a large degree in size are almost impossible to fuse and, in the effort to do so, the observer suffers considerable eye strain. Even small differences in size cause some eye strain. It is generally accepted that the differences in size should not be greater than ½ per cent. This means that there should be only about one inch difference in height size between the two images on an 18-foot by 25-foot screen. Some ophthalmologists believe that twice this discrepancy is permissible.

VERTICAL ALIGNMENT

Another important requirement for comfortable viewing of projected 3-D is that both images are accurately aligned horizontally.

One image should not be higher or lower than the other. If vertical displacement is present the observer will suffer visual discomfort. The greater the vertical displacement the greater the discomfort. Such displacement should not be greater than three inches on an 18-foot screen to prevent visual discomfort for an observer about 40 feet from the screen.

Vertical displacements were sometimes apparent in the first few 3-D motion pictures released in 1952 and early 1953. In some cases vertical displacements resulted from improper camera work, but most frequently they have been introduced in projection. When interlocked dual projectors are employed the projectionist must be constantly on the alert to correct for vertical displacements if they should occur.

ROTATION

If there is any rotation between the members of the 3-D pair, in other words, if one image cants in relation to the other, fusing difficulties are set up. The two images should be in accurate attitude alignment, one with the other. Rotation is not likely to appear in 3-D movies since the camera optics are very carefully adjusted and projectors are nearly always set up level.

ILLUMINATION

The two lenses in the 3-D camera should pass substantially the same amount of light for each image in order to obtain negatives of like contrast and density. Some leeway is permissible, but for color negatives, such as Eastman Color, Ansco Color and Technicolor Monopack, the difference in exposure should not be greater than permitted by a ¼ lens stop.

In projection, the illumination for one image should match closely that for the other. If one image is much darker than the other the depth in the scene disappears and the observer suffers visual discomfort. This can be attributed partly to the fact that when bright light reaches one eye both irises close down; both irises do not open up when dim light falls on one eye.

We may conclude that eye strain certainly results if the projected 3-D picture contains images of different sizes, have vertical displacement and unequal illumination. But there is another important matter that has not been emphasized strongly enough in the past and has been neglected by a few stereographers, and that is the possibility of misinterpretation of the 3-D picture. In other words, the observer is confused about spatial relationships, sizes of objects, and other subjective, little understood factors.

Misinterpretation of a 3-D picture with regard to depth has been all too common among observers. Some scenes have appeared deeper than normal and well-known objects have taken on strange forms. These conflict with the individual's experience and misinterpretation is the result.

The misinterpretation of a 3-D picture usually is the result of improper photographic techniques. Sometimes they can be traced to the employment of the wrong interaxial spacing (distance apart) of the camera lenses. The proper interaxial spacing when taking the 3-D picture must be calculated for the ultimate size of the projected picture. For motion picture work we can assume that a standard screen width (aspect ratio of 1 to 1.3) will be about 25 feet, a magnification of the film of about 360 times. For wide screen 3-D having an aspect ratio of 1 (vertical) to 2 (horizontal) interaxial spacing calculations should be based on a magnification ratio of 520. No attempt will be made to include the equations used in the calculations and which are based upon magnification ratios, since they are of interest chiefly to the stereo technician.

The principle embodied in the establishment of interaxial spacing can be illustrated in general by a simple diagram. (fig. 1)

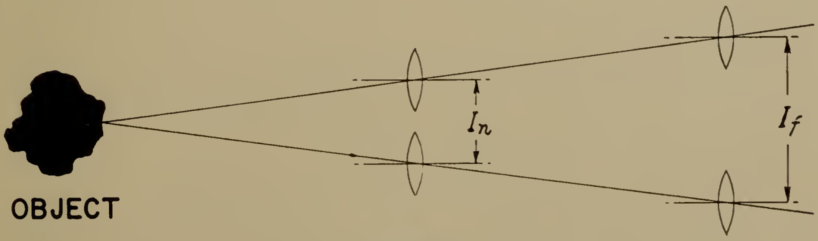


Figure 1

If we consider the angle subtended by lines drawn from the centers of the lenses to the object we can readily see that the spacing between the lines forming the angle is less when close to the object than when farther away. The human eyes are incapable of changing their spacing. The only thing they can do is to converge at a greater angle when close to the observed object.

When the eyes converge, they swing inward in their sockets, and might be said to aim toward the point of convergence. The angle of convergence for normal eyes looking at an object 10 feet away is about 1° 12′—for an object 10 inches away it is about 14°. (fig. 2)

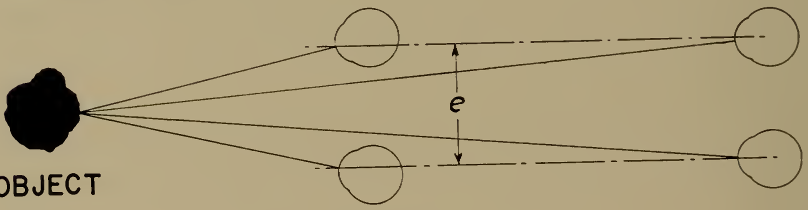


Figure 2

Convergence of camera lenses must be employed in order to produce satisfactory 3-D pictures but convergence should be held to a fairly narrow angle, and not permitted to be as great as the convergence angle tolerated by the eyes when looking at an object, say ten inches away. The convergence angle for the lenses should be kept under 2° except for very unusual conditions, but in no case should a convergence angle larger than 5° be used.

To get back to interaxial spacing: if it is too large the 3-D picture will suffer from "miniaturization"; objects and people will look smaller than they should and the depth of the scene will be abnormally increased in relation to the real spacing of objects.

If the interaxial spacing is too small the 3-D picture will suffer from "giantism"; objects and people will look larger than they should, and the depth of the scene in relation to the spacing of objects becomes drastically reduced.

Miniaturization, false depth and proportion distortions have been evident in many scenes in recent 3-D movies and are a result of using interaxial spacings for medium shots and closeups much greater than the human interocular, which is about 2½ inches. On closeups it is always required to have the lenses spaced apart considerably less than interocular. Giantism has not been so evident because most cameras used in 3-D motion picture work are incapable of extremely small lens spacings, but it has frequently been observed in the projection of 3-D stills on large screens when such stills had been taken with extremely small interaxial spacings.

The phenomenon of giantism may be interpreted differently by different people. With some, the giantism may pass unnoticed if the true sizes of the objects photographed are known. With others, it may be immediately apparent and sometimes annoying.

Unlike giantism, which may not be noticed by some, miniaturization passes unnoticed by few.

There isn't anything intrinsically unpleasant about miniaturization of objects some distance away but it distorts reality and can never give a re-creation of real objects in size and shape nor their real spatial relationships to each other. Miniaturization of objects close to the camera often adds so much distortion as to produce unacceptable effects, such as the abnormal lengthening of an outstretched arm, or throwing the head out of any semblance of real proportions. The chin to throat distance increases beyond all reason. The subject becomes skinny.

The peculiarities of miniaturization have been mistakenly interpreted by some writers and directors and have, by them, been stated as a fundamental characteristic of all 3-D photography. For instance, several men have said, that for 3-D, actresses should be plump; the svelte favorites of the past would have to stoke up on fat-producing food. These statements appear ridiculous to all who have a fundamental understanding of the stereoscopic art. It isn't necessary to remodel the bodies of the cast, nor is it necessary to select only plump persons for 3-D. All that is necessary is to select the correct interaxial spacing of the camera lenses to produce pictures that show people and things in their true proportions.

Other statements by some in Hollywood conflict with the true facts relating to 3-D photography.

One of these, repeated several times, has been that boy and girl must play much closer together, for if they're apart by as much as one foot, 3-D will show them separated by three or four feet, often a totally abnormal distance between people playing an intimate scene. This is just as valid as the statement relating to a special bodily build for 3-D filming.

Yes, there is a reason for this depth distortion: Too great an interaxial spacing of the lenses for the distance between camera and players.

An interesting effect obtained in using an excessive lens spacing is to produce much miniaturization in the near distance, somewhat less in the middle distance, and virtually none at all in the far distance. An example is the playing of a scene in which a mountain range in the far distance forms the background. The players may be reduced in size to pygmies; the mountains will look perfectly natural.

Another requirement of importance to good 3-D presentations is the employment of a "stereoscopic window," that imaginary portal through which the projected picture is viewed.

No object should be permitted to invade the plane where the window exists if that object "touches" any part of the window frame. If it does, the result is a distracting border which gives non-coincidental image reconstitution.

If the "window" is at infinity, as it will be with parallel lens axes, the illusion will be that foreground middle distance and part of the far distant planes are between the window and the observer, a totally abnormal effect.

To create a proper window illusion the masks framing the images must be identically alike in shape and size and their horizontal margins must be level.

Masks can be of any shape. For instance a keyhole mask will provide a stereoscopic view through a keyhole, an anomalous effect since keyholes are so small that real-life peering through one is limited to one eye.

Where objects do not touch the window frame (the picture margins) they can be permitted to come through the window and even made to seem suspended in space between the screen and the observer.

Properly to form the stereoscopic window 3-D cameras must be provided with some means to converge the lens axes to any desired plane, usually to a plane in front of the nearest object.

The importance of convergence in stereophotography for projected pictures has long been recognized. Of course, the use of convergence introduces certain problems and calls for a profound understanding of the conditions under which it is used.

Two simple methods of convergence have been employed. One is by toeing in the cameras, one by sliding the lenses. (fig. 3)

The toe-in method produces a very slight distortion in a different direction for each member of the stereo pair. But for all practical purposes, this distortion of the rectangle is so very slight that it can be disregarded unless the interaxial spacing is very great, especially when it is considered how much greater an angular toe-in is employed in dual projection. Its disadvantage in use is that it adds to the bulk of a dual camera assembly if the cameras themselves are swung to the convergence angle. With swingable mirrors the convergence control need not take up much room. The easiest and quickest convergence control is with the sliding lens method. (fig. 4)

An effect often built into the early 3-D features is the cutting off of a body. The severed body seemingly floats in space between the screen and the observer. Such a totally unrealistic effect is nauseating to some people. It is a stereoscopic presentation that

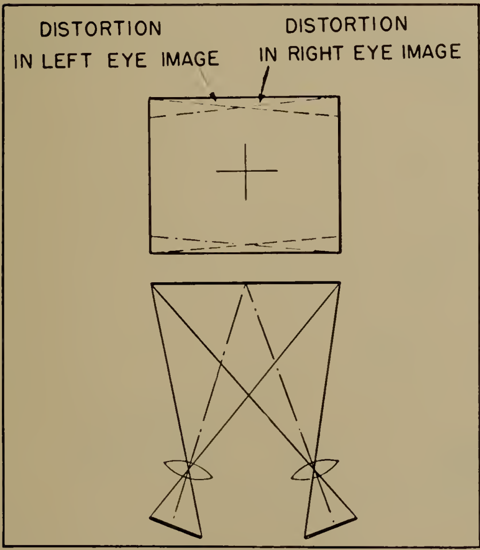


Figure 3

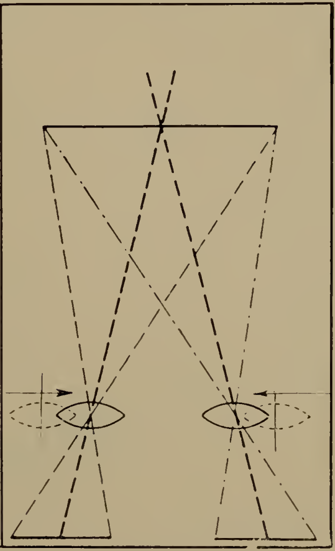


Figure 4

permits only a false interpretation because it is completely false in itself, and is produced by converging on a plane behind the body. (fig. 5)

There are great leeways in convergence in front of the body. If it is desired to have it close behind the window, convergence is made closely in front of the body. If it is desired to show the body farther behind the window convergence is made farther in front. There is no plane whatever behind the body that permits convergence there, if the body touches anywhere on the window, top, bottom or sides. An exception, as pointed out before, is in cases where an object doesn't touch the margins, such as a trombone, which may be permitted to extend through the window.

In 3-D photography there is an interlocking relationship between the convergence point and the interaxial spacing of the lenses. In general, it can be stated that the angle of convergence increases slightly as the distance from object to lens decreases, and the interaxial spacing decreases as the distance decreases. Some camera arrangements permit the employment of reduced interaxial spacings in shooting closeups, others do not. Unless the

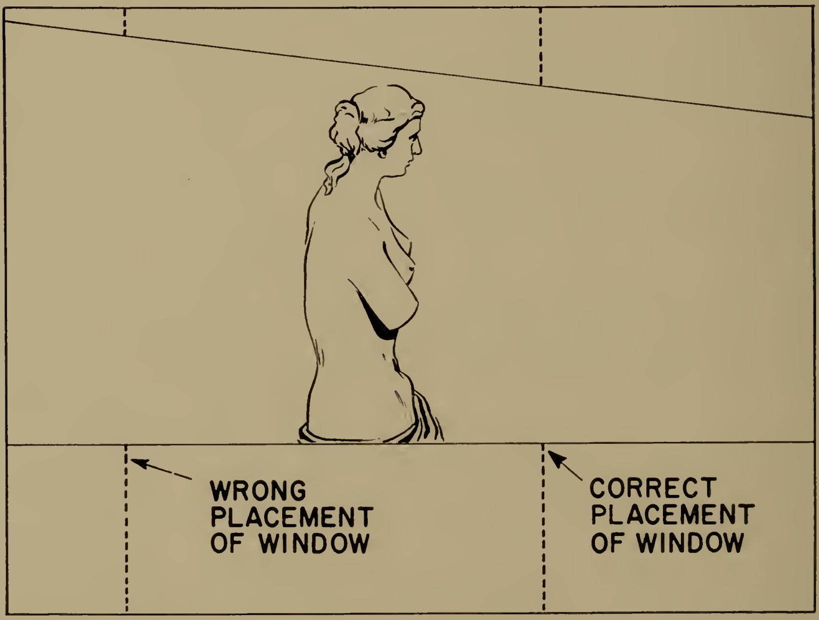


Figure 5

camera permits the use of reduced interaxials, serious restrictions in versatility are imposed on the camera.

The major effort in 3-D camera design is expended in providing the camera with facilities for making pictures having acceptable interaxial spacing and for convergence of the lens axes so that stereoscopic windows can be formed at desired planes. Some of today's 3-D camera setups provide for both these controls, a few provide for only one.

Most of today's stereoscopic motion pictures have been made with cameras not specifically designed for the purpose. Bulky camera arrangements have been employed, with the two separate cameras mounted on a common base and sometimes provided with mirrors or prisms to provide paths for the rays of light from the scene to be reflected into one or both lenses. One early arrangement consisted of two cameras mounted side by side.

Camera arrangement No. 1, with both camera lenses pointing toward the scene, imposes the use of a very large interaxial spacing of the lenses. If the cameras are placed heads up alongside each other the minimum interaxial spacing will not be less than about seven inches employing regularly used studio cameras.

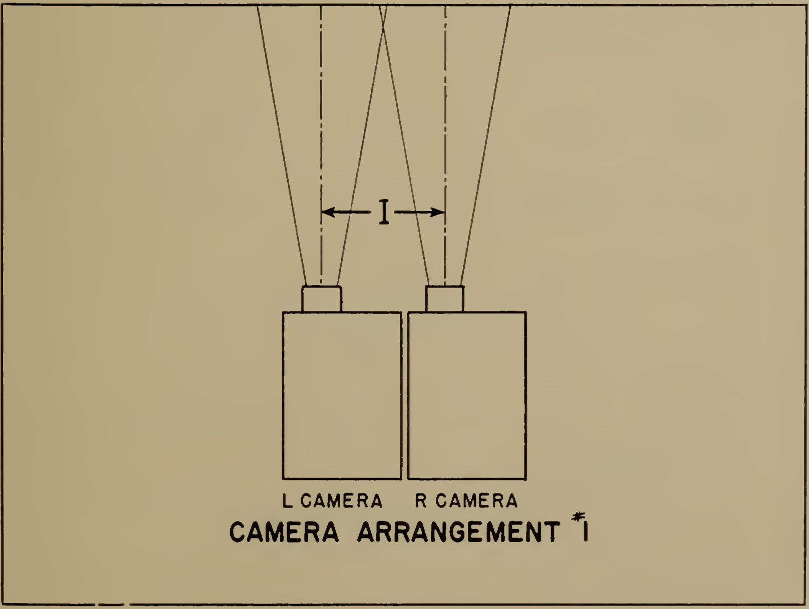


Figure 6

Convergence can be accomplished by toeing in the cameras. This arrangement, with its excessively wide interaxial spacing produces excessive miniaturization and is unsatisfactory except for the photography of very distant subjects. (fig. 6)

By mounting one camera upside down in relation to the other, the interaxial spacing can be reduced considerably.

This arrangement was used with two Bell & Howell cameras for the production of three pictures during 1938 and 1939, namely, the two Chrysler Motors Exhibits at the New York World's Fair in 1939 and 1940 and the Pennsylvania Railroad's Exhibit at the Golden Gate International Exposition in San Francisco in 1940. This arrangement provided a minimum interaxial spacing of 3¼ inches, which is somewhat less than employed for many scenes in recent Hollywood productions, but which is far too great for successful photography of close objects.

The arrangement was bulky but permitted the use of lenses of any focal length desired and many of the shots for these productions were made with 25mm, 35mm, and 75mm lenses, although 50mm lenses were most frequently employed.

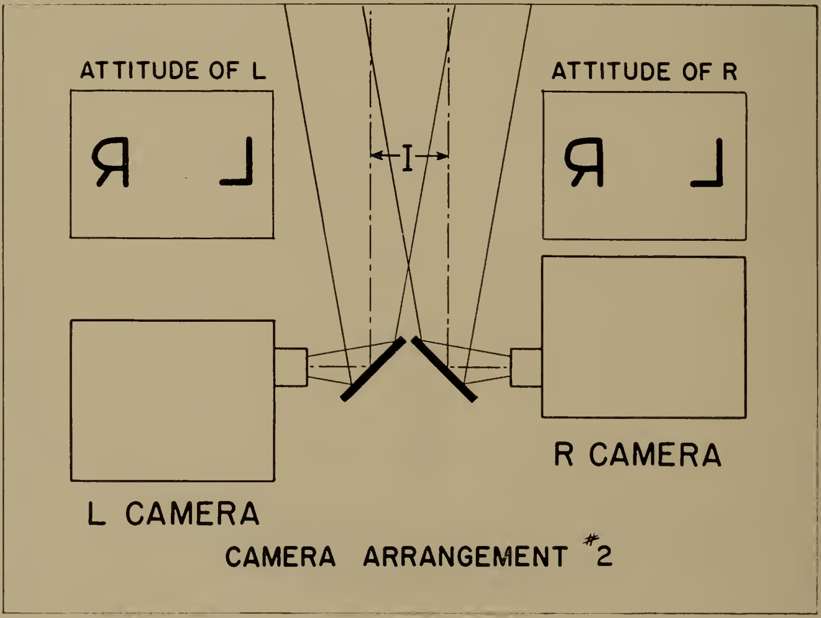


Figure 7

Camera arrangement No. 2 shows two cameras, whose lenses point into first-surface mirrors, which, in turn reflect light from the scene. We tried this arrangement in 1931, and discarded it. The closest interaxial spacing, without very special machining of lens mounts and camera fronts is about three inches with 50mm lenses. Convergence can be obtained by swinging the mirrors a small amount. This particular arrangement does not permit the use of 25mm or 35mm lenses unless interaxial spacing is increased to about six inches for 25mm lenses and about 4½ inches for 35mm lenses, totally abnormal interaxial spacings and ones that will result in extreme stereoscopic distortions. (fig. 7)

The negatives produced by this arrangement will make contact prints whose attitudes are reversed left for right. Restitution, of course, can be made by optical printing from the negatives or optically producing dupe negatives which can be contact printed.

Camera arrangement No. 3 shows one camera pointing toward the scene and the second camera pointing into a first-surface mirror which reflects the scene into the second camera's lens. This arrangement permits a somewhat closer interaxial spacing

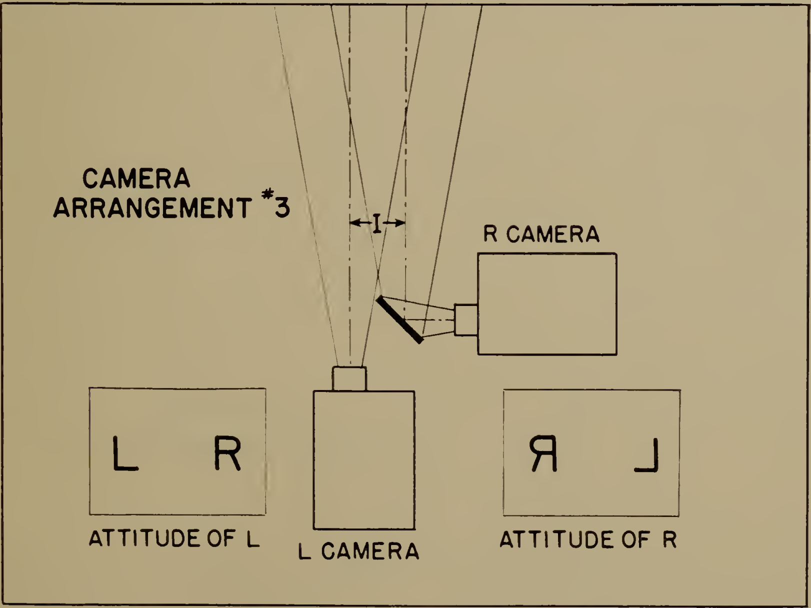


Figure 8

than arrangement No. 2, provided the lens mounts and camera fronts are machined down to accommodate for the desired conditions. By special machining the interaxial spacing can be reduced to about 1½ inches which is as close as is ever necessary to go with lenses of 50mm focal length. With 35mm lenses the probable interaxial spacing will be about 2¾ inches and with 25mm lenses about 4 inches. Convergence is obtained by swinging the mirror over a small arc. (fig. 8)

There is some reduction in the light reaching the camera which gets its image from the mirror. But this is probably not serious since the reduction equals only about enough to require a ¼ lens stop increase.

The bulky camera arrangement was employed from 1933 to 1935 in Leventhal and Norling's production of "Audioscopiks," a series of shorts narrated by Pete Smith and released by Loew's, Inc., and later the same design was employed by MGM in the production of a short novelty called by them "Metroscopiks." It is a common arrangement in Hollywood today (1953) and is fast

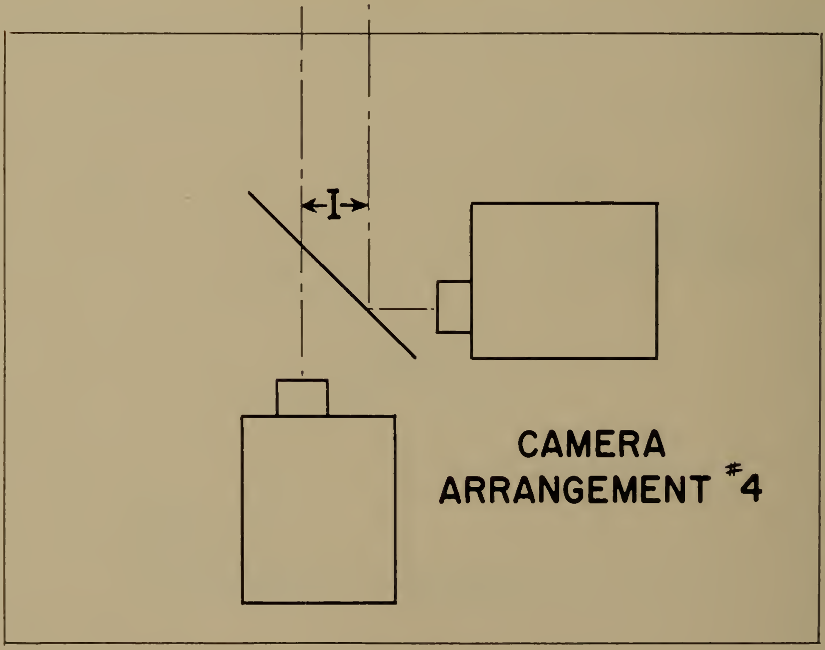


Figure 9

replacing arrangement No. 2 which was used for the first 3-D features. We discarded this system in 1938.

Camera arrangement No. 4 shows two cameras, again an arrangement suffering from a spreadout placement of cameras and inherently as bulky as the arrangements of No. 1 and No. 2. But it has certain advantages which appeal to some stereo technicians. By the use of a transmission-reflection mirror and one camera placed at 90° to the other with the mirror between, at 45° to each camera, it is possible to work with an interaxial spacing from zero upwards, if that is desirable. Whether extremely small interaxial spacings are necessary depends largely on the point of view of individuals proposing them, and their preferences are not necessarily based upon practical conditions. Interaxial spacing if too small produces giantism in the projected 3-D pictures and a considerable reduction in the depth of the scene. If small spacing is carried far enough the 3-D picture loses all depth and will have about the same appearance as a 2-D picture. (fig. 9)

An analysis of this system shows that part of the light passes through the mirror directly from the scene of the first camera and part of the light is reflected from the mirror to the second camera. Reflection and transmission losses permit only about 40 per cent of the light to reach each camera. This means that the illumination must be increased 2½ times.

If conventional photography requires 600 foot-candles this particular arrangement would require 1500 foot-candles. The delivery of this much light on a set might very well cause discomfort to the players and, in cases where such a light output is unavailable, would call for wider lens apertures and consequent loss of sharpness throughout the depth of the scene.

One of the negatives produced will have its attitude reversed as in arrangement No. 3.

One advantage of this system is that it permits the use of lenses of extremely short focal length, provided the mirror is made large enough to accommodate wide angles.

Convergence can be obtained by swinging the mirror.

Many persons, including Prof. Clarence Kennedy and employees and associates of Polaroid Corporation used this camera arrangement for still stereography prior to 1940 and the author experimented with it and used it in 1941 for motion pictures, but soon discarded it because of the difficulty of aligning the mirror and keeping it spotlessly clean.

The four basic arrangements possible with dual interlocked cameras have been shown. Now will be described some stereo camera designs employing a single camera body. It is interesting to realize that the earliest cinestereo cameras had the single body design.

A 35mm two-film camera was used by Frederic Eugene Ives between 1900 and 1905 in producing stereo motion pictures. The two lenses were mounted with fixed centers 1¾″ apart. They were coupled together for focussing and for diaphragm settings. The magazines were mounted within the camera body and had a capacity of 200 ft. each.

Several persons have used similar setups since the time of Mr. Ives' experiments, and some have built and used cameras in which the two members of the stereo pair were exposed on the same film. The pioneer stereographer, J. F. Leventhal, whose Plastigram anaglyph films were widely exhibited from about 1921 to 1924, designed such a camera in 1934.

This was a rebuilt World War 1 Universal 35mm camera. Its lenses of 12mm focal length were mounted .48″ apart and produced the two pictures side by side, each .36″ by .48″. The film movement was changed to pull down two sprocket holes. Mr. Leventhal and the author made many scenes with this camera, of small forms of life such as tropical fish, large insects, etc. The extremely narrow interaxial spacing (.48″—equivalent to about ⅞″ interaxial with full-size 35mm frames) and wide angles of the lenses permitted this kind of very closeup stereophotography. Printing negatives were produced by enlarging to standard 35mm frame size in an optical printer.

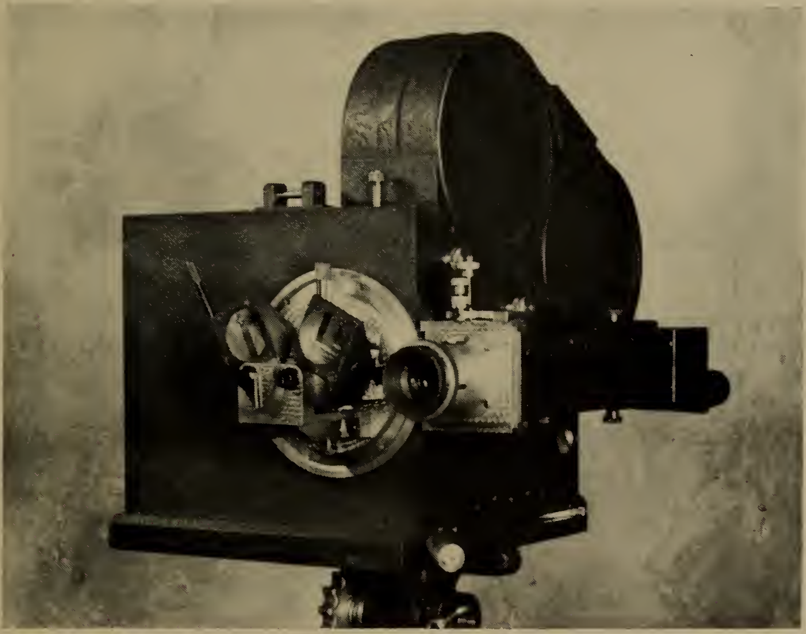
Until the time of this writing only two single body 3-D cameras have been available for 35mm motion picture photography. These are a camera designed by Carroll Dunning and one designed by John A. Norling. Both have been used in production.

The Norling 3-D camera is unique in that it provides a wide range of control for varying the convergence and for varying the interaxial spacing.

The lenses are shifted horizontally for convergence control—the closer the point of convergence the closer the lenses. It's very easy to use the convergence control. All that's necessary is to refer to a table prepared for the various interaxial spacings and read off the micometer setting to place the window where desired.

The single-body camera permits simultaneous focusing control of the two lenses, very difficult if not impossible to incorporate in the dual-camera design. With simultaneous focusing it is impossible to focus one lens to a different point than the other, thus assuring equal sharpness and depth of field for each of the two lenses.

My objective, when I built my 3-D camera, was to have it handle equally as conveniently as a conventional camera. The assistant cameraman, all by himself, can lift it on its tripod and carry it over the shoulder. This single stereo camera is able to get into any situation that a conventional studio motion picture camera can get into, and without the aid of special carrying conveyances, special trucks or special setups. Anything that can be photographed by a conventional studio camera can be photographed just as readily, just as quickly, and just as conven-



The Norling 3-D camera.

iently with this 3-D camera. With photoplay production budgets running into thousands of dollars a day, this of course is very important.

Of course 3-D photography can be obtained, within certain definite limits, with a two-camera system, and even with a fixed interaxial, and even with a mirror convergence system. But all scenes which can be photographed by a conventional camera cannot be photographed as readily, as conveniently or as quickly with a two-camera system, and indeed, certain scenes that can be photographed with a conventional camera, or with a single stereo camera, cannot be photographed at all satisfactorily with some of the two-camera systems which have been thus far described in the press.

3-D Projection

Projection of 3-D films by interlocked projectors and using polarized light is the commonly used method today. It is not new, by any means. The author employed it in 1939 and 1940 at the New York World's Fair, using electrical interlock and in 1940 at the Golden Gate International Exposition, using mechanical interlock. Both electrical interlock, usually with 115 volt AC selsyn motors, and mechanical interlock are in use today. Both systems give good results if properly designed. Mechanical interlocks having excessive play or back-lash are completely unsatisfactory.

The projector heads must be in excellent condition, and parts which are worn should be replaced, otherwise the 3-D projection will be unsatisfactory. It is particularly important that worn intermittent mechanisms be replaced. Intermittent sprockets that have any undercutting of the teeth should be discarded. A worn intermittent will introduce differential jitter vertically between the two films in dual projection. Side shoes should guide the film so accurately that no side play is evident on the screen. Vertical jitter and noticeable side play will detract from the effectiveness of 3-D projection and will cause visual discomfort to many in the audience.

Satisfactory 3-D projection demands constant attention of the projectionists. They must thread the two films so that they are in frame-for-frame synchronization. If they are as much as one frame out of sync all sense of depth in fast moving objects is lost and a very annoying effect is introduced on all objects in even slight movement. It becomes impossible for the audience to determine just where these objects are located in spatial relationship to their surroundings.

Not only must the projectionist carefully make sure the films are in exact sync, but he must also make sure that there is no vertical displacement between the two images. If vertical displacement does occur he must instantly correct it or the audience will suffer eye strain.

Of course, the projection lenses must be matched, to within plus or minus ¼°, so that the projected images will be very close to equal size. If they are not, many people will suffer eye strain. There are some people who suffer considerable difficulty in fusing the images if they differ as much as a two-hundredth part, one from the other. While it is true that a small percentage of people can tolerate as much as three per cent size difference we cannot consider them representatives of humanity for the purpose of establishing tolerances in 3-D projection.

An annoying effect sometimes noticed in 3-D pictures has been the appearance of double images in contrasty scenes. This has usually been due to improper mounting of the projection polarizers, sometimes to the use of polarizers which do not adequately polarize the light. The polarizers, whether placed on the projection ports or mounted on the lenses, must have their polarization axes aligned to an accuracy of less than 1° tolerance. If they are not mounted so that their axes are in accurate angular relationship to the horizontal they will fail properly to polarize the light at the angle it should be polarized.

Sometimes doubling of the images is due to faulty polarizers in the viewing spectacles. Some polarizing viewers recently released contain striations and areas in which polarizing elements are partially or completely absent. There is nothing that can be done to deliver satisfactory 3-D pictures to the audience if it is supplied with faulty viewers, no matter how fine the projection equipment and how accurately made are the adjustments of projection components.

Projection polarizers must be spotlessly clean, a difficult condition to maintain unless the polarizing films are mounted between good quality covering glass. Uncovered plastic polarizers cannot be cleaned by ordinary methods. Attempts at cleaning them result only in imparting minute scratches that ruin the quality of pictures projected through them. Some cleaning compounds react chemically with the plastic to produce cloudiness, rendering them completely useless for their intended purpose.

Dual projection of 3-D pictures is being employed at the present time, because no other system has yet been manufactured. But it is not the ideal system, nor is it even a good system, when all the factors in connection with it are considered. The dual-film system uses twice the amount of film required for conventional motion pictures. It requires special equipment, such as very large and costly projector magazines (25″ diameter and 50 lbs. in weight when fully loaded with film). It requires much taller rewinders than have been used for the 200-ft. reels commonly used. It requires the projection booth be equipped with a synchronizer, something not needed hitherto. The dual-film system exacts a very heavy toll in inspection and repair time in the film exchange, perhaps as much as four times that required for a conventional film. And, finally, shipping costs are increased by almost two times.

Perhaps all these costs have been warranted by the public's acceptance of 3-D as reflected at the box office. But it is reasonable to assume that eventually 3-D will have to adopt a single-film system. Several such have been proposed, some of them having excellent possibilities as far as the delivery of good 3-D to the screen, and all of them having the potential of reducing print, handling, shipping and projection costs.

Possibilities of 3-D

The full possibilities of 3-D have not been explored. Among all the developments of the 3-D art, there is one which has some of the greatest potentials, and that is binaural sound. Binaural sound will give each ear its own sound signals just as stereoscopic photography gives each eye its own picture signals. Binaural sound is quite different from stereophonic sound. It provides the ultimate in sound reproduction, as far as giving a sense of location of the sound source is concerned.

It doesn't merely "tell" whether the sound source is at the left or right or in any other direction; it pinpoints the sound source in space, and in its exact direction, tells not broadly that it's from left or right but tells exactly where it is to the left or right and how far away it is. Binaural sound is true 3-D sound. It doesn't seem to come from loudspeakers in front, to the sides, or behind. It seems to emanate directly from the lips of an actor, from the oboe playing the obligato, from the place where water drips from an overflowing gutter, from a mischievous boy barely seen behind the shubbery. It is as different from stereophonic sound as a big picture is different from a small picture.

Stereophonic sound is exciting, is effective, particularly for wide screen presentations of conventional films. It is doubtful whether binaural sound would contribute much to 2-D wide-screen movie, but it certainly would add the *ne plus ultra* to the 3-D wide-screen presentation. And 3-D wide-screen movies can be produced and presented. There are no technical problems unique to 3-D that don't exist for 2-D wide-screen.

We may look forward to wide-screen 3-D as an early embellishment of the art, and to the eventual wedding of binaural sound with wide 3-D, a wedding whose consummation would undoubtedly result in that most pleasant sound, the clinking of coins in the box office.

We have mentioned the stereoscopic window and its necessity for existence in standard 3-D presentations. The stereoscopic window is something that has been contrived to achieve coincidental image reconstitution and to avoid marginal disturbances. We don't have to have this window if certain 3-D photographic and projection procedures are employed. It is perfectly possible to have 3-D pictures existing in space whose margins are vignetted, gradually shaded off from outer darkness to the full illumination of the picture itself. Some optical problems exist in the methods of doing this, but they are not very difficult to solve.

CONCLUSION

Whatever the course of development of the 3-D art, one thing is certain: All the fundamental rules applying to proper photography and projection must be observed. Infraction of any of these rules may set up disturbances; may give the audience an unpleasant experience.

THE Natural
Vision camera
is lined up by
producer-
director-writer
Arch Oboler for
a scene in
"Bwana Devil",
first 3-D feature.

What Is Natural Vision?

MUCH of the credit for the boom in 3-D goes to Milton L. Gunzburg, a screen writer, who in association with his brother, an eye specialist, decided stereo films were practical. His Natural Vision Corporation, despite many obstacles, worked out a satisfactory 3-D system from camera-to-theatre and arranged with Arch Oboler for the production of the first feature, "Bwana Devil". Mr. Gunzburg also has served as adviser in connection with several other 3-D productions.

by M. L. Gunzburg

IT IS ONLY to be expected that a great deal of misinformation must exist regarding anything as new and revolutionary as Natural Vision, and yet as old as stereoscopy.

Most existing misinformation regarding Natural Vision 3-D and 3-D in general, stems chiefly from the fact that most experts in the field are of necessity "three-week" experts. I say this apologetically because some of the more recent arrivals have been at it all of six months. Indeed, ever since the memorable opening of Arch Oboler's history-making "Bwana Devil," the public libraries have been deluged by experts hot after the somewhat limited literature on Three-Dimension. But here lies the rub. Most of the past literature on 3-D motion pictures is hazardously out-moded and as apt to confuse as to educate.

Heretofore the greatest strides in stereoscopy were made around the turn of the century when the old stereoscope in grandmother's parlor was the TV set of its day. At that time the accepted method of photographing stereo stills—the only 3-D photography of that day being still photography—was to put two cameras side by side on an adjustable base (adjustable in that the separation between the two cameras could be varied at will) and shoot straight ahead. If the object were close by, the two cameras were shoved together to approximate the distance between the two eyes of, let us say, a mouse. If the object were far off in the distance, the cameras were separated to as much as ten inches, approximating the distance between the eyes of a very large elephant. Thus the principle of the "variable interocular," born out of *still* photography, found prominence at the turn of the century.

Motion picture 3-D for the next fifty years followed the traditional "variable-interocular" principle and in spite of a few brave attempts remained limited to the short subject and primarily to the halls of World Fairs, National Festivals, etc. And this restriction remained necessary because of the taboos placed on 3-D movies by the "variable-interocular" type of photography and the fact that 3-D cameras in most all instances photographed directly ahead (as though the eyes in the head peer straight forward, which they do not), all of which made it impossible for audiences to tolerate 3-D for more than a reel or two without suffering serious eye discomfort.

Among the taboos limiting this old-type of 3-D were the inability to intercut easily and normally, the lack of portability of the show (3-D films in most instances were designed for a specific size screen and a specific throw, depending upon the exhibition hall in which they were to be shown). In other words, and this is an historical fact which should not be ignored if it is one's intention to seek out the truth, 3-D was strictly limited to the side-show, to the one or two-reel novelty—until the advent of Natural Vision in November of 1952.

What then happened with the advent of Natural Vision? Why was it cause for the 3-D revolution? Why was no feature attempted until its arrival? Why did we not enjoy this box office bonanza thirty years ago, ten years, three years ago?

The truth is simple. It was not possible to have 3-D feature-length motion pictures until Natural Vision provided the missing link that made 3-D come of age, that eliminated eye-strain, that made 3-D motion picture photography professionally practical and commercial. And the missing link, to put it briefly, is that Natural Vision out-moded the former artificial "variable-interocular" and introduced a system that duplicated the physiological function of the eyes, incorporating and emphasizing the heretofore never employed or properly used principle of "convergence."

A lucky circumstance was responsible for this. As a writer and producer, I felt the answer to TV was 3-D. Fortuitously I have a brother who is not only an eye specialist but a top ranking amateur photographer. As anyone on visiting an ophthalmologist's office can observe, stereo devices are the everyday tools of an eye specialist. Sixty per cent of eye therapy and perhaps eighty per cent of eye diagnosis involve the use of stereopsis. Thus it was almost in the cards that with my interest in stereo and my brother's knowledge of the eye that we employed his knowledge of medicine in appraising the potentials of Three-Dimension. Diverting from the established principles of optical physics we sought to develop a system that would reproduce the physiological functions of the eye.

The eye is not, as has been assumed by many experts, purely a lens. It is rather a living, rapidly scanning organ, and it is nearest to being the center of our nervous system. Involved within the eye structure is a group of related muscles, each having a special function, perhaps the most important of which is to converge the eyes upon the object the brain has sought out.

Likewise the cameras used in the Natural Vision method of shooting are so set up that they provide a natural, automatic convergence on the subject of greatest interest in any given scene—just as do the eyes.

Thus, if properly photographed and projected, films in Natural Vision should cause no eye-strain on the part of the audience. In fact, numerous medical authorities have stated in the last few months that viewing properly projected 3-D films is excellent therapy for the eyes. Patrons, for the price of admission, receive as much eye benefit in some instances as they might from experiencing a dozen treatments for exercises in a doctor's office.

One thing we at Natural Vision cannot emphasize too strongly is the importance of proper photography and proper projection. Picture makers owe a great responsibility to the public and to the industry to see that all 3-D photography is of the highest standard. Likewise, theatre owners must take every care to assure the very best projection practices in the booth. In fact, the coming of 3-D has served to jack up the standards of excellence in every technical department of the motion picture business. In photography the two pictures must be perfectly matched, and there is no method of obtaining two equal prints short of perfection. A camera that is not absolutely perfect cannot be paired with an imperfect camera. Since the two prints are projected simultaneously, the laboratory must see that they are

ON LOCATION for "Fort Ti", 3-D feature in color by Technicolor made by Columbia Pictures with the Natural Vision system.

perfectly balanced. Methods of synchronization, lenses and arcs must be better than anything the industry has known to date. And this challenge has proven stimulating to everyone who has worked with 3-D.

As we progress, many of the remaining taboos and prejudices retarding 3-D eventually will be broken down, such as the taboo held by many influential "three-month" experts that all action must be held behind the screen. We feel this is a false taboo and that audiences seeing more and more 3-D will agree with us. To insist on a screen or window between the action and the audience is to keep pictures artificially behind a flat barrier. We in the initial stages of Natural Vision felt there was danger in coming out into the audiences' laps too often. But we have changed our minds. Depth, whether before or behind the screen, is the real dramatic tool in 3-D. It is to be used.

One hears a great deal these days about wide-screen, giant-screen, etc., to all of which, incidentally, Natural Vision is compatible, and about which we are most enthusiastic. Yet our greatest enthusiasm is for the "no-screen." We feel that the day will come, and soon, when audiences will watch a motion picture performance as though the screen were eliminated entirely, and life itself unfolded.

Natural Vision has enjoyed a most rapid and steady improvement in its photography. Beginning with Arch Oboler's "Bwana Devil," which was an heroic first attempt on a limited budget, progressing through Warner Brothers' history-making "House of Wax," applying improvements in equipment for Columbia's "Fort Ti," progressing even further with Warners' magnificent "Charge at Feather River" and their highly dramatic "The Moonlighter," and reaching a new high in technical perfection in RKO's outstanding "Devil's Canyon", which six months ago we would not have dreamed possible, we feel that Natural Vision has come of age, and that it will remain as an ever-improving dramatic tool for men of talent for many years to come.

The Stereo Window

TRAINED to be a mathematics and physics teacher, Floyd A. Ramsdell left the classroom in 1918 to devote his energies to the Worcester Film Corporation, producers of industrial, scientific and educational films. He made the first professional 3-D motion picture for Polaroid in 1937. Since that time he has been interested in stereo films and has taken out several patents, including one on a camera system, issued in March, 1953.

by Floyd A. Ramsdell

THE THEATRE motion picture screen is a flat screen. It has two dimensions, width and height, and the action takes place physically on this flat surface.

With stereo pictures, there is introduced a profound difference from a picture produced by a single image—that is, by two-dimensional photography and projection. When stereo pictures are accurately made, properly projected, and viewed with image-selective spectacles, our flat screen takes on the effect of an opening. Action now can seem, not only to recede into the distance beyond the opening, but to come forward through the opening.

This apparent opening is the stereo window; and since it has a visual effect comparable to that of an actual window, it behooves the producer of three-dimensional pictures to photograph and to project his stereoscopic pictures in such a manner that his audience will view them in true proportion.

We have perception of depth in normal life because each eye sees and conveys to the brain a slightly different image. The brain fuses these two images into a single image which has depth.

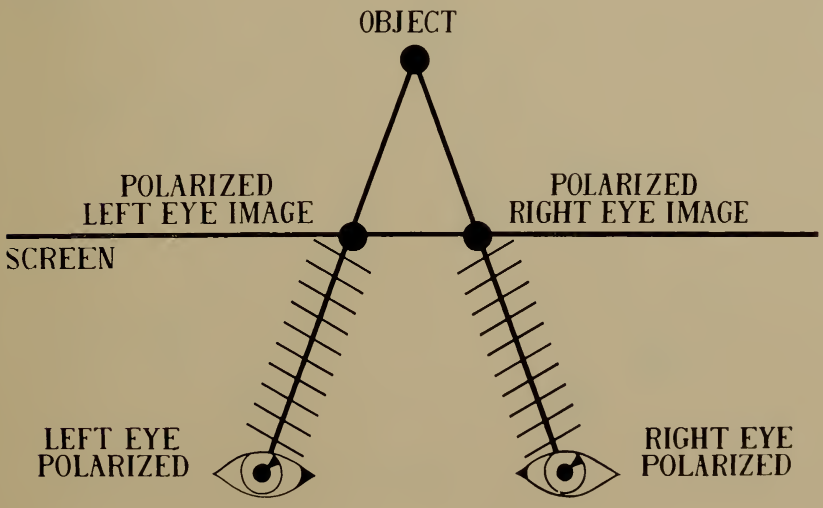
If we are to get the proper illusion of depth from viewing a pair of projected stereo images, we must supply the brain with information in a manner simulating the way it receives sight data in normal life. That is, the left eye must see and convey to the brain *only* the left-eye picture, and the right eye must see and convey to the brain *only* the right-eye picture.

To accomplish this, we polarize the projected images and view those images through similarly polarized viewers, a different polarization for each eye.

Thus each eye sees and conveys to the brain the particular image intended for that eye, and the brain rewards us by translating that pair of views into a single picture with depth.

The inherent difference between the left-eye picture and the right-eye picture helps to give to the object the appearance of a three-dimensional solid.

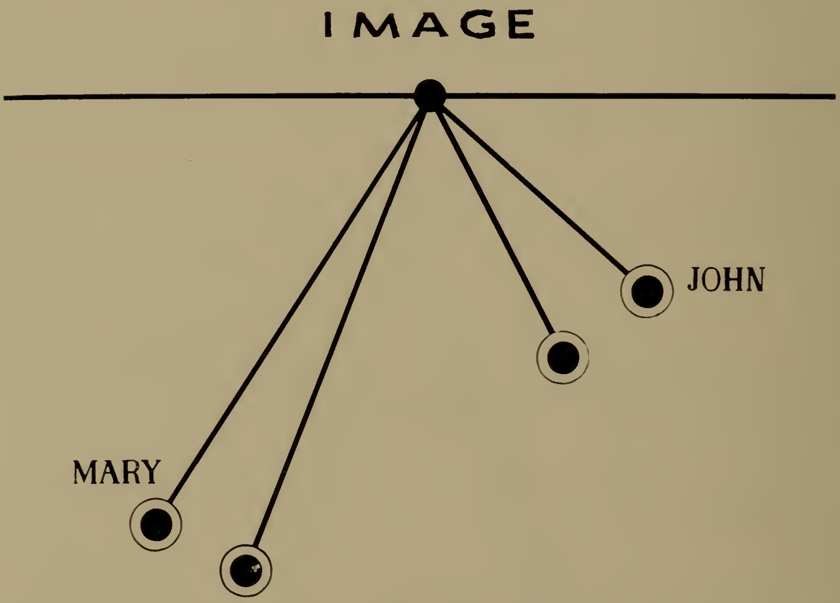
The amount of separation on the screen between the left-eye image and the right-eye image of an object determines how far "behind the screen," so to speak, that object will seem to be to a person in the audience who is looking at it through polarizing viewers.



A few simple drawings will illustrate how definitely this separation of images will locate an object with relation to the screen for the person viewing that screen.

It is not necessary to go into detail on the theory of polarization of screen images and the use of polarizers to view those images. The simple fact to remember is that to a person wearing his polarizing viewers, the *left eye* is channelled only to the *left-eye image,* and the *right-eye* channelled only to the *right-eye image.* Where those lines of sight *meet* is the *location of the object* with relation to the screen for that individual.

In Case 1, the left-eye image and right-eye image exactly superimpose on the screen when viewed *without* polarizing spectacles. When we put on our polarizing viewers, each eye is led to the same spot on the screen. Hence, that object will seem to be *at the screen.* In fact, a person standing at the screen could seem to touch the object. The object is at the screen and at identically the same place on the screen *for everyone in the audience;* for John who sits in the sixth row, and for Mary who sits in the twelfth row.

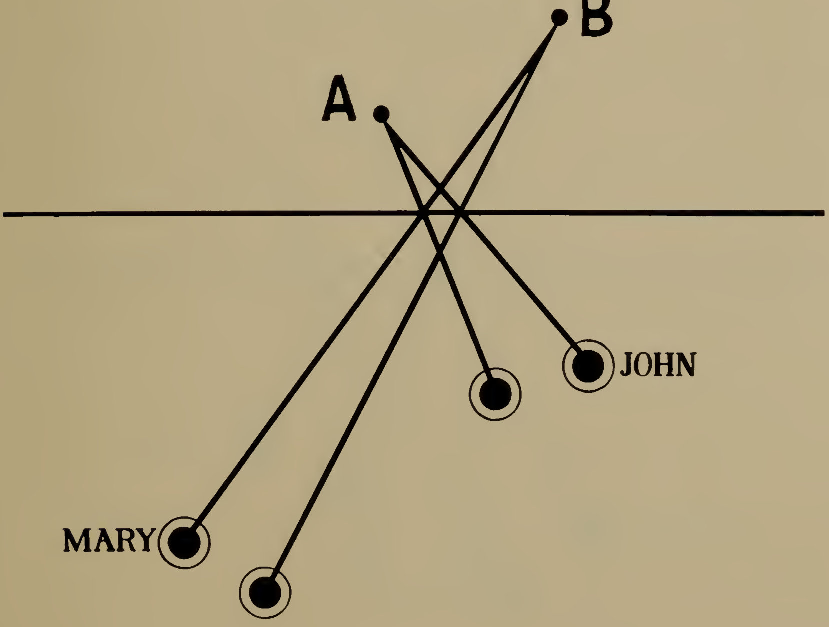


Case I

In Case II, the left- and right-eye images of an object (homologous points) when viewed without polarizing spectacles, are *separated* on the screen. Again, when we don our polarizers, each eye is directed to its particular image. The point at which a line from the left eye to the left-eye image, intersects a line from the right eye to the right-eye image, fixes the distance the object seems to be "back of the screen" for that individual. *A* is the location of the object for John ; *B* is the location of that same object for Mary, who is sitting twelve rows farther back and to John's left.

Here is the evidence that depth is enhanced the farther the viewer is from the screen. Here also is evidence that each person in the audience gets a somewhat different concept of the scene.

In Case III, the left-eye screen image is separated from the right-eye image by two and one-half inches, an amount of spacing approximately equal to the distance between the eyes. Because polarizing viewers channel each eye to its respective image, these

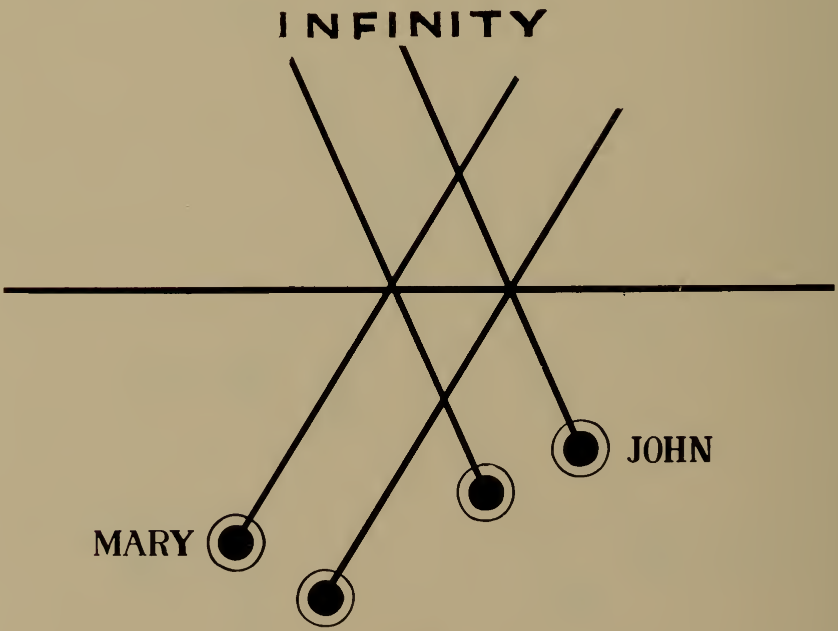


Case II

lines of sight are parallel. Since parallel lines meet at *infinity* the object will seem to be at infinity for everyone in the audience. The object will have a different location laterally for Mary than it does for John, but regardless of where either sits in the auditorium the object can only be at infinity.

If left-eye image and right-eye image are separated by more than the normal interocular distance of 2½ inches, our polarizing spectacles, by channelling each eye to its respective image, will try to turn our eyes out, a feat which is unnatural for normal eyes, and serious eye discomfort will result. This is plain evidence that left- and right-eye *screen images* of the object farthest from the camera must never be separated more than 2½ inches (normal eye separation) when they are projected. (Case IV).

Here also is clear evidence that the *screen size must be known at the time the stereo picture is photographed,* and the correct interlens separation of the camera calculated to give the correct depth effect *on that particular size of screen.*



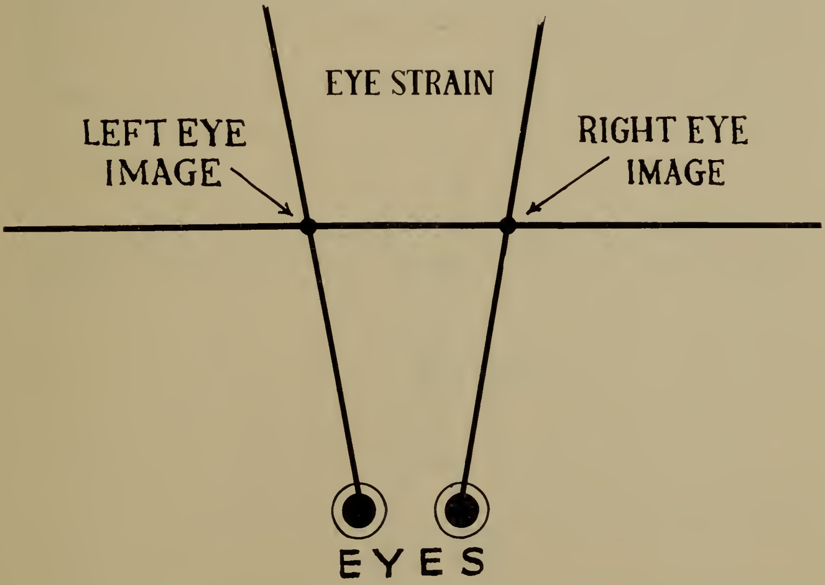
Case III

One other problem is of interest when considering the location of the images on a stereo screen. In Case V, the right-eye image and left-eye image are reversed; but, again, our polarizing viewers channel each line of sight to its correct image. Since these lines of sight intersect in front of the screen, the object will appear to be in front of the screen.

Consideration of the simple principles illustrated in these five cases will show how important it is to be able to control the location of left- and right-eye images when they are to be projected on the screen.

To summarize these points:

> Eyes can converge at the screen as in Case I, and for everyone in the audience—regardless of where he is seated—the object, whose left- and right-eye images superimpose, will be at the screen, and at the same point on that screen.
>
> Eyes can converge back of the screen as in Case II. In this case, the object will not only be in a different lo-



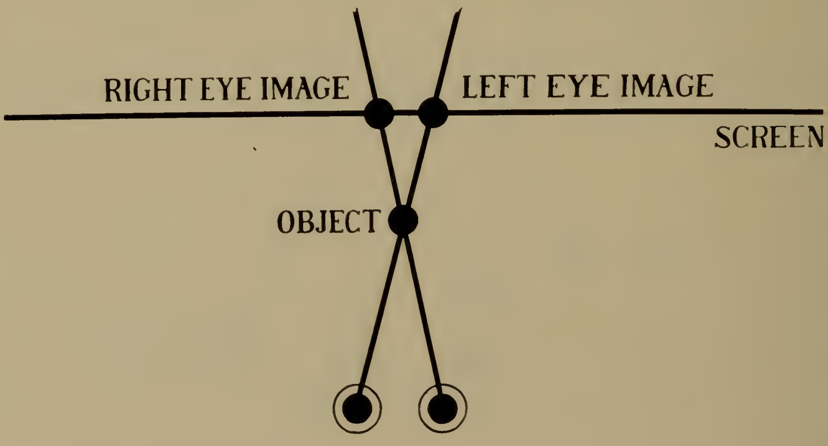
Case IV

> cation for every person in the audience, but will also vary in distance back of the screen for persons sitting at different distances from that screen.
>
> Eyes can sight along parallel lines as in Case III. In this case, the object will vary laterally for every one in the audience, but will be at infinity regardless of where they sit.
>
> Eyes cannot toe out, and serious eye discomfort will result if left- and right-eye images are separated by more than normal interocular distance (Case IV).

These considerations show us that while width and height of our *stereo window* are fixed by the size of the screen, apparent depth—that is, the distance the objects in that scene seem to be back of the picture window—depends solely on the separation of left- and right-eye images of those objects on the screen. This third dimension, depth, is determined by the separation of the optical axes of the camera lenses when the picture is photographed.

Unless care is taken in choosing the correct interlens, distortion and even serious eye discomfort can result. This Third Dimension, therefore, is the one that needs careful study by the producer of theatre films.

While visual *perception* of depth is due to the fact that our



Case V

eyes are separated laterally, a person's mental realization of depth is profoundly affected by his past experience.

All our life has been spent in a Three-Dimensional world, and we have a vast accumulation of knowledge concerning the relative size, location and spacing of objects.

That past experience is not only of profound importance to our concept of depth in actual life, but of equal importance when we view a scene through the stereo window in the theatre.

The depth of the scene we are viewing must be in as true proportion as if we were viewing it in reality, or our past experience will tell us that something is wrong and we shall have a feeling of unease, and in some cases actual discomfort.

The apparent depth of a scene is determined solely by the relative separation of left and right images of that object on the screen. It is imperative, therefore, that the producer take his pictures with such separation of images that the projected images will give the viewer a *correct* illusion of the depth of the scene depicted.

At the beginning of this discussion we noted that the stereo window has a visual effect similar to that of an actual window. So real is that comparison of the stereo screen to a window that objects can seem to come through that window towards the viewer.

Unfortunately many producers of three-dimensional pictures have taken totally unwarranted advantage of this window effect, forgetting that the people who view those pictures have a concept of a window which is the result of a lifetime of experience.

Our knowledge of a window is very definite. We know that we can lean out of a window or reach an arm through, or throw something out of that window. But we know just as definitely that we cannot have someone walk to that window, and, if his legs are below the bottom frame of that window, still continue to walk through that frame towards us. In effect his legs would be back of the screen while his torso came into the audience.

The reverse separation of images on the screen (Case V) makes this seem to occur but our past experience tells us emphatically that it cannot happen. We cannot break the bottom frame of that window.

Let's take one more simple case. This time the reverse separation of images makes it possible for an arm to be waving out of that stereo window. If that arm moves to the side, so that the hand intersects the vertical frame, the hand becomes invisible. Our past experience immediately tells us that if the hand is hidden by the frame it must be behind the frame.

By virtue of reverse separation of left and right eye images the arm is in the room, but past experience says emphatically that the hand must be behind the frame.

Thus our past experience is so important a part of our concept of a window that if we allow objects to appear in front of our stereo window which would have to break either the horizontal or vertical frame of that window the mind will not accept the screen evidence. In fact, we instinctively try to put those objects back of the window where they belong.

The mental conflict which results gives many people who are viewing such a scene a distinct feeling of unease which is not conducive to good entertainment.

The best illusion of depth on the theatre screen is the result of a picture presentation which gives the viewer the idea that he is looking through an actual picture window at a normal scene.

That means that the depth must be in true proportion to the size of the screen and the "frame" of the stereo window must not be broken.

3-D in Europe

REPORTING on the European 3-D scene, Frank A. Weber's interest in the subject is traced back to his father, who in 1910 worked with Louis Lumiere on stereo photography. Mr. Weber is an engineer with headquarters in The Hague specializing in 3-D research and consultation as well as international patent matters. He is managing director of VeriVision Holdings, a Dutch 3-D research group. His company has developed its own camera and shooting system.

by Frank A. Weber, M.Sc.

THE FACT THAT the United States has enjoyed in 1953 a lead over Europe in the matter of 3-D feature production is mainly due to a more cautious attitude on the part of film producers and financiers. Furthermore, there has been in Europe, at least up to 1953, no direct threat to the motion picture industry from television. Another factor is that high entertainment taxes do not encourage new experiments in entertainment. (In contrast with entertainment taxes in Europe the twenty per cent tax in the United States seems moderate.)

European 3-D specialists feel that testing of shooting methods and cameras—leading to standardization—must precede extensive 3-D feature production in the European film capitals. Sir Michael Balcon, among others, is a spokesman for this point of view.

However, throughout Europe there is a firm foundation of 3-D "know how" including inventions of basic importance in the commercial development of the art. As always the diversity of nations proves to be fertile soil for new ideas. In this connection it may be recalled that the current 3-D boom actually started through the initiative of the British Government, the British Film Institute and the Canadian Film Board which made the 3-D program of shorts exhibited at the 1951 Festival of Britain.

The writer predicts that as soon as the flurry of excitement over 3-D production in Hollywood has quieted down sufficiently to permit broad testing and experimentation, it will be found that European inventors have developed excellent shooting methods and cameras.

Production. Production began in the early Spring of 1953 on the first European 3-D feature, "Bella Su Misura" ("Beauty to Measure"). It was filmed in Italy with the Christiani camera. The second 3-D film, also an Italian production, "Odyssee" ("Odessey") was scheduled to be shot in June, 1953, with 3-D cameras made by the Richardson Corporation of Burbank, California.

Plans have been made in various other countries, including France, Germany and Britain, for 3-D features. In England a documentary of the Coronation was filmed in 3-D on June 2 by Associated British-Pathe in association with Stereo Techniques. In previous years 3-D filming has been confined to short subjects, including newsreels and sponsored productions.

The first 3-D picture made in Germany after World War II was released early in April, 1953. It was a 17 minute advertising short on "Volkswagon," popular West German auto. It was shot with the Zeiss camera and the Vierling 3-D shooting system.

In 1948 the writer produced in VeriVision what he believes was the first 3-D newsreel in color. It showed a procession passing before Queen Juliana following her ascension to the throne. Similarly filmed was probably the first 3-D puppet picture, a two-minute advertising film, "Star of the Screen." It was also produced in Holland and completed in April, 1953.

During the period from 1951 to 1953 several entertainment and advertising shorts have been made in England with the Dudley 3-D camera and the Stereo Techniques shooting system. These included "A Solid Explanation" (1951), "The Black

Swan" (1952) and a newsreel "London Tribute" (1953). With the same system but using two Technicolor cameras, "Royal River" was filmed in England in 1951. Most of these shorts were shown early in 1953 in the United States under the name of Stereo Techniques and TriOpticon. Shorts made in England during the first three months of 1953 were "Capstan Cigarettes," "3-D Musical" and "A Day in the Country."

Although Europe was slow in getting into 3-D feature production following World War II, several features were made before the war. These include "Nozze Vagabonde" ("Beggar's Wedding"), Italy, 1936; "Zum Greifen Nah" ("You Can Nearly Touch It"), Germany, 1937; "Sechs Mädel Rollen Ins Wochenend" ("Six Girls Drive Into the Weekend"), Germany, 1939. The Italian film was made with the Gualtierotti camera; the two German productions with the Zeiss camera and the Vierling shooting system.

All these films, pre-war and post-war, were exhibited in the polarized light system, i.e., polarized filters were installed at the projectors and each member of the audience wore polarizing viewers. The Zeiss Company in Germany manufactured these glasses on a commercial basis in 1936. Independently, at about the same time, they were also made in Germany by E. Käsemann and by J. Mahler.

The Zeiss Company has claimed that "Zum Greifen Nah" which had its premiere at the Berlin Ufa Palast theatre on May 27, 1937, was the world's first color-sound-stereo film.

Standardization. In European film circles it has been agreed unanimously that testing of 3-D methods and decisions on standardization should be done through international and intercontinental cooperation. It is important for Hollywood producers that Americans cooperate because eighty per cent of the theatres of the world are outside the United States and abroad the American film industry was reported to have earned 140 million dollars in 1952.

There are well established technical and trade associations in the principal countries involved so that exchanges of data should be facilitated. It seems essential for the future of 3-D that at least provisional standards be agreed upon for characteristics of cameras, shooting systems, screen dimensions, aspect ratios and size of the film frame. Already Germany has proposed a provisional 3-D standard. France seeks adoption of a standard placing both the left and the right eye image on one 35mm frame.

As the Chinese say "One look is worth a thousand words," so the common opinion among 3-D experimenters in Europe is that 3-D shooting methods should be subject to a uniform visual test. After that theoretical discussions of the best method should follow. The writer has devised a visual test and has found great interest in European film centers in arriving, in consultation with U. S. experts, at a standard test which could be used all over the world. If such a standard test were agreed upon, technical results of various 3-D films could be judged objectively.

Besides standardization on 3-D methods at the earliest possible moment, there should be international agreement on screen sizes and aspect ratios. The call for a wider screen has been made repeatedly in Europe in recent years, just as there has been a call for 3-D. The problem of the panoramic screen is not new to Europe. In France in 1926 a director, Abel E. Gance, took out a patent (No. 633,415) for a multiple projector panoramic screen system. In 1937 Professor Henri Chretien, in collaboration with the Compagnie de Production et de Distribution d'Electricité, showed at the Paris Exposition of 1937 pictures on a screen measuring 60 x 10 metres.

The open-air theatre in Berlin—said to be the largest in the world with a seating capacity of 25,000—has a huge panoramic screen. However, it is felt in Europe that wide screens have a diminishing value as the spectator is seated farther away from the screen. A screen in standard size presents a larger picture to a person sitting fairly close than a panoramic screen does to a spectator in the back rows of a large theatre.

Nevertheless it is felt that some widening of the screen is important, as especially the *vertical* borders of the standard screen hamper the true 3-D perception. This is due, in the view of the writer, to the fact that the present screen has an aspect ratio of 1.33 to 1 while the total field of human view is approximately in the proportions 1.65 to 1.

It would be difficult to express a "European view" on such a subject as the best aspect ratio because so many have been proposed and strongly advocated. However, it is the writer's opinion that the general feeling is that the new aspect ratio should not be smaller than 1.65 to 1 nor larger than 2 to 1. The matter of the aspect ratio is inseparably bound up with the problems of projection magnification which is so vital in 3-D.

Many believe that the ultimate form of the film will be 3-D on a wide screen. In this connection mention may be made of the proposal of a Frenchman, J. Vivie, and others, that the aspect ratio should be variable, depending on the nature of the scene filmed.

3-D Shooting Methods. There is a marked difference between the U. S. and British on the one hand and Continental developments on the other hand with regard to 3-D shooting techniques. In the United States, Canada and Britain shooting methods have been based on the mathematical-geometrical theory of Professor J. T. Rule of Massachusetts Institute of Technology (published in 1941). This problem has been tackled on the European continent from a different starting place, namely, the psychological-physiological reactions of the spectators viewing a 3-D film in a theatre. This approach springs from the studies of the German scientists Von Helmholtz, Hering and Von Kries.

One such system is VeriVision, developed in Holland by F. H. Reijnders and revised by the writer. It follows a variable-interaxial and constant—very small—convergence principle. It is believed that the minimum possible lens interaxial should be used as is consistent with obtaining *full natural depth.* Too great inter-axial may result in eye strain for members of the audience who see, in varying degrees, 3-D less easily than "normal" persons.

Another well-known European 3-D shooting method is the one developed around 1935 by O. Vierling for the Zeiss Company in Germany. This method is based on what is called "the 70 arc-minutes condition." It was used for the three German 3-D features.

In England a 3-D shooting method, Stereo Techniques, has been developed by the brothers N. L. Spottiswoode and R. Spottiswoode, and J. Smith. Another was worked out by H. Dewhurst for the Ministry of Supply. Both are based on the principles set down by Professor Rule. Mr. Dewhurst's system uses a fixed inter-axial, a method elsewhere advocated only by the Natural Vision Corporation in the United States.

In Switzerland some 3-D shooting rules were computed by E. Millet of Paillard-Bolex for making 16mm amateur films with the two images on the same strip of film. This method is intended for projection on small screens only.

While no other shooting systems other than those outlined above have been proposed in Europe, it is believed that the best way to make 3-D pictures is neither so simple as Natural Vision (fixed-interaxial and variable convergence) would have it, nor as complicated as Stereo Techniques with its approximately eighty interconnected formulae and rules. Many in Europe think the truth lies in the middle.

3-*D Cameras*. While theoretically the shooting system, aspect ratio and type of lens to be used should all be determined before a 3-D camera is designed, in practice it is understandable that most designers and inventors of 3-D cameras have followed the reverse course. While there are only about ten 3-D shooting systems or variations of systems, there are hundreds of 3-D camera patents and numerous non-patentable designs.

An ideal 3-D camera, according to studies by the writer's 3-D Research Group in Holland, should have the following characteristics:

1. The lens interaxial should be variable from 10mm (or 15mm) to 200mm with the camera in operation.
2. The convergence of the lens axes should be variable from between 0.3° to 3°, also with the camera in operation.
3. It should be possible to use wide-angle lenses in combination with all lens interaxials which have been specified above.
4. The left and right eye images should both be of standard size (or nearly that large) to result in sufficient screen brightness, especially with wide screens. The images should be shot simultaneously through separate lenses and projected simultaneously.

A number of leading European 3-D experts believe that a 3-D film should be shot as much as possible with wide angle lenses. This is suggested for three reasons: a) to approach "free viewing" as much as possible; b) to have the greatest possible range of sharp definition, and c) because the limit of projection-magnification where divergence of the eye-axes is noticeable is at a higher magnification ratio than with lenses of greater focal length. Standard lenses with a focal length of 20mm for 35mm pictures and 9.5mm for 16mm films fulfill all the needs for panoramic 3-D films. Wide-angle lenses demand small lens interaxials and that is why designing a suitable 3-D production camera has become "a battle for the small lens interaxial."

A brief description of some European 3-D cameras follows:

1. The German Zeiss camera has a lens interaxial range of from approximately 20mm to 60mm. It makes two images 11 x 14mm side by side, rotated 90° on one 35mm film strip. Incoming light rays pass five reflecting surfaces in front of the lens proper. Present lenses used have a focal length of 40mm. Pictures made with this camera are projected through a standard 35mm projector equipped with a "derotating" and superimposing attachment in front of the lens.

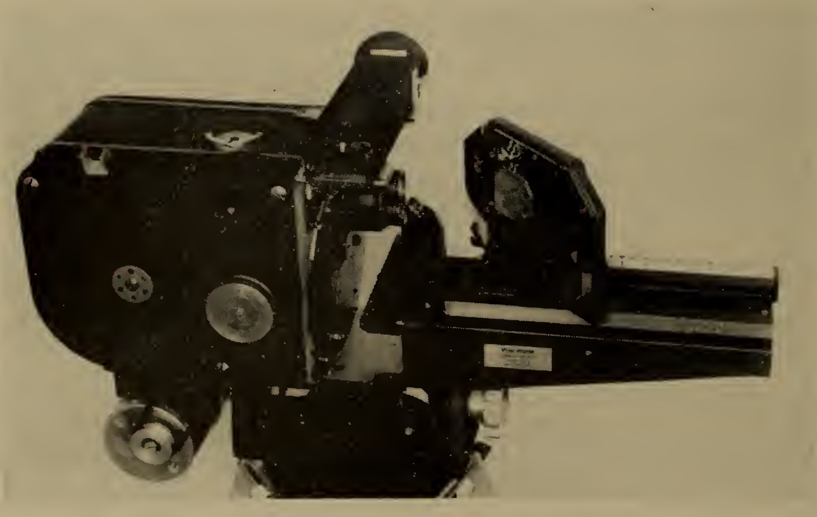
2. The English Dudley double 35mm camera (provisional British Patent No. 17.086/50) uses two opposed Newman & Sinclair cameras and large mirrors mounted at a 45° angle. Its minimum lens-interaxial, when wide angle lenses are used, would appear to be about 60mm and the maximum is reported at 200mm. It was used for all the English 3-D shorts made in 1951, 1952 and 1953 with the exception of "Royal River."

3. The Italian Christiani 35mm camera splits the left and right eye image onto a standard 35mm frame. Each of the four images is the approximate size of a 16mm image. It is reported that this camera uses a fixed interaxial of 65mm. When projecting these pictures there must be correction for vertical parallax and a high degree of precision in the manufacturing and mounting of both camera and projector lenses. Magnification in projection is also a problem because each image is so small. The Christiani camera was originally designed for color

film making through the use of four color filters and a black and white negative. The French Roux camera had a similar original purpose.

4. The Dutch VeriVision camera shoots simultaneously the left and right eye image on a single 35mm film strip. Each image has the dimensions of 13.5 x 22mm instead of the usual 16 x 22mm. The pairs are photographed simultaneously. Camera and projector require a six sprocket hole pull-down instead of the normal four. (Cinerama uses a six sprocket hole pull-down in both camera and projector). Projectors could convert to the use of standard 35mm pictures by the use of interchangeable sprockets and gate. The VeriVision camera's interaxial range is from 7mm to 200mm. The lenses are placed in their mounts one above the other and there is an automatic correction for the slight vertical parallax (the vertical interaxial distance is 14.5 mm). In another model of the camera the lenses are placed side by side while the left and right eye images remain in their positions one above the other.

5. The English Stereo Techniques camera was completed in 1953. It involves improvements based on that company's experi-



VERIVISION 3-D camera showing lenses mounted one above the other for photographing off a mirror setup.

ence with the Dudley camera. It is reported that a somewhat simplified technique of shooting has been worked out by means of electronic computing.

6. The Juillet camera designed by P. Juillet of the Relief-Lyon-France Company places the left and right eye image horizontally one above the other in a standard 35mm frame. In front of the single lens of the camera is placed a special attachment which includes two anamorphoser lenses to compress the picture as much as is consistent with the aspect ratio into each half frame. Projection is made through the use of a pair of expanding lenses attached to the single projector.

In Europe the projection of 3-D films follows generally much the same lines as those adopted in the United States. However, there are some European contributions to the all-important problem of increasing screen brightness as needed for both 3-D and panoramic pictures. These include means of cutting down the heat at the aperture, of increasing the output of the carbon arc and explorations of a projection lamp using Xenon gas. Various improved screens have also been worked out.

Conclusion. As far as could be demonstrated within the scope of this article, it can be stated that Europe has made and continues to make numerous contributions to the development of 3-D and panoramic motion pictures. Close cooperation between the United States of America and Europe therefore seems essential to make the development of the new screen techniques as swift and efficient as possible. In this respect there is ahead a major task for the various technical and trade associations in the leading film countries.

Technicolor and the New Screen Techniques

IN ALL the new screen techniques color plays an important role and the first name in color is Technicolor. The Technicolor company, headed by Dr. Herbert T. Kalmus, has developed a 3-D camera of its own but its basic contribution to the new arts and applications of the film is to give each the best color possible in the circumstances. Color is essential in most 3-D and wide screen pictures.

by Dr. Herbert T. Kalmus

THE CONTINUING POLICY of Technicolor Motion Picture Corporation is to undertake research, to design, engineer, and then to make technical laboratory facilities available to the motion picture producer and distributor.

At this time the world-wide motion picture industry is endeavoring to bring about a third point in its evolution. Sound was the first evolutionary point, color was the second and the third and present point is an attempt to achieve new effects by new photographic, laboratory and screen techniques. Some of these techniques are directed toward more complete illusions of depth by means of stereoscopy. Other techniques attempt to obtain greater audience participation by wide angle screens having various degrees of curvature. Some involve different arrangements of the spatial relationship of images and others include utilization of stereophonic sound, i.e., multiple sound originating at different points within the theatre.

These evolutionary points are not opposed. As sound and color mutually enhanced one another in the art of motion picture story telling, they will continue to benefit that art in the new screen techniques. Because the new screen techniques place increasing emphasis upon color, Technicolor welcomed the invitation to contribute to this book. As should be expected, this contribution will be primarily related to color through modification and expansion of Technicolor's technical facilities which are available to the world-wide motion picture industry through its international laboratories.

There seems to be little question that the new motion picture techniques, involving three-dimension and wide angle screens, are bringing the day of an all-color screen appreciably nearer. Even before the coming of the new techniques, the ever-increasing use of color was regarded as a natural progression. Now color becomes more important than ever.

The emphasis on 3-D and wide screen is in the interest of increased entertainment value. Technicolor Motion Picture Corporation takes the position that the new screen techniques can provide maximum entertainment value only by using color.

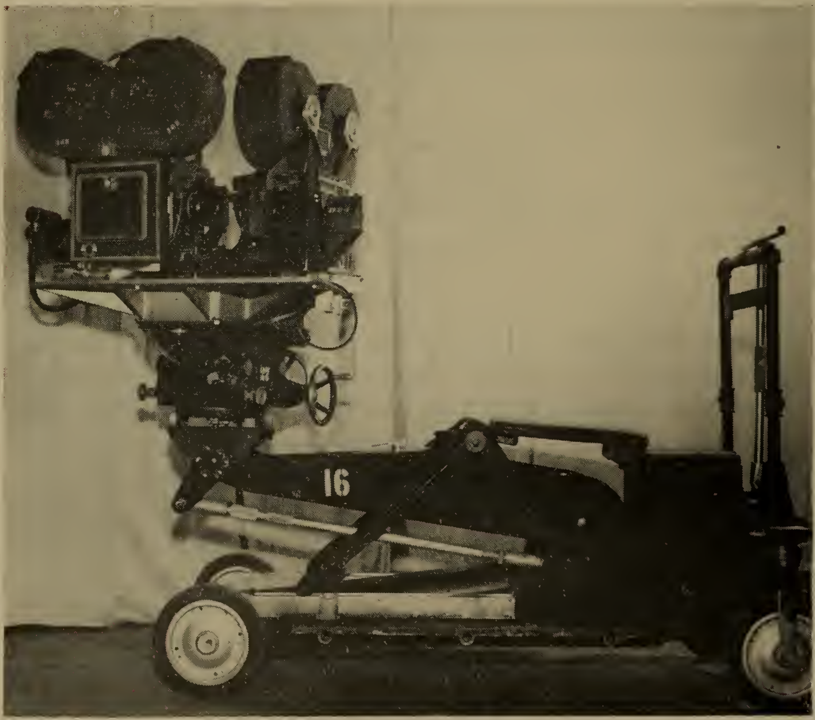
Historically speaking, stereoscopic or three-dimensional techniques are not new to Technicolor. Prints for pictures requiring red and green glasses were made by Technicolor in 1926, in its then current two color process. In 1936 Technicolor made prints for "Audioscopiks," requiring the use of red and blue-green glasses. In 1940 Technicolor made three-dimensional, three-color motion picture prints which required viewing through polarizing glasses. These prints were shown by the Chrysler Corporation at the World's Fair in New York. In addition, Technicolor followed the important work of Henri Chretien in the early 1930s, as well as the exploratory work done by Twentieth Century-Fox and others at that time. At present Technicolor is servicing the motion picture industry with color facilities for all techniques.

To date, neither Technicolor Motion Picture Corporation nor its affiliates have advocated any particular technique for creating an illusion of depth. Technicolor believes it is possible that some combination of the present systems may prove to be the ultimately accepted method for creating the new illusions.

But whatever technique or techniques are eventually accepted by the public, it is the purpose of Technicolor to extend to the world-wide motion picture industry the required technical facilities.

The Technicolor three strip motion picture cameras have long been, and continue to be, an important factor in motion picture photography. Starting with negatives exposed in these cameras it is customary to make imbibition or dye transfer release prints from matrices printed from the negatives. This Technicolor camera continues to be available to the motion picture producer for use in stereoscopic, wide angle or flat screen photography.

More recently, there has been introduced into the color motion picture art the single strip color negative. The single strip color negative stock is exposed in an ordinary single strip

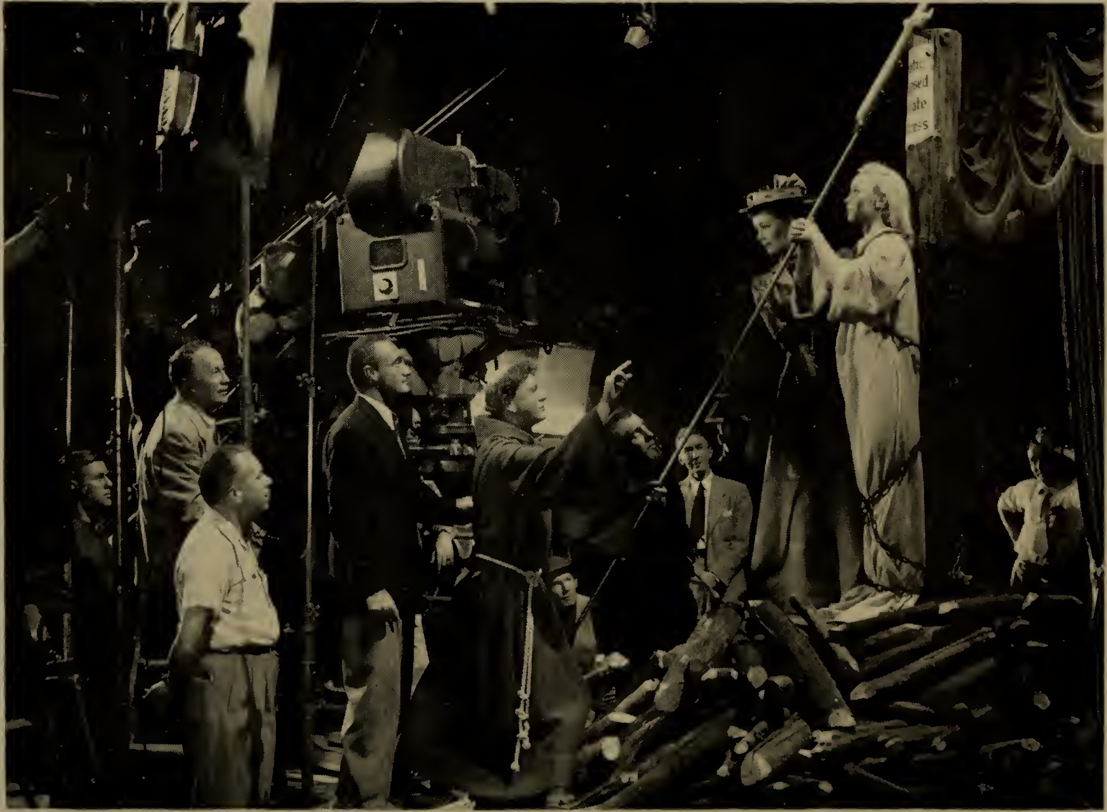


TECHNICOLOR three-strip 3-D camera consisting of two cameras in a special mounting.

motion picture camera which may be adapted for stereoscopic, wide angle or flat screen photography. The single strip color negative records three image aspects in color, in three emulsion layers, on a single strip film base. It has generally been thought that this type of negative was suited only for making color positive prints by the direct printing method.

An important contribution which Technicolor offers to the motion picture industry, at this time, is the ability to obtain Technicolor dye transfer prints from these single strip negatives, that is, greater flexibility. Technicolor has successfully developed new laboratory facilities and techniques which permit the motion picture producer to do his initial photography on color negative stock and *then* determine whether his release prints shall be manufactured by the direct printing method on positive stock or by the dye transfer method. Starting with color negative, it is now possible for Technicolor to manufacture release prints of either the direct positive type or the dye-transfer type. Both types have their advantages. But the particular advantage to the producer is that the dual choice gives him greater flexibility in his initial photography and subsequent decisions regarding print orders.

Technicolor will continue its research, design and engineering aimed to make available to the motion picture producers and distributors everywhere the finest technical facilities in the world.



TECHNICIANS prepare to film a scene for Warner Bros.' record breaking 3-D feature, "House of Wax," filmed in WarnerColor and released with WarnerPhonic sound.

1927, Sound—1953, 3-D

THE Warner Brothers have always prided themselves on being pioneers, and it was not surprising that Col. Jack L. Warner, head of Warner production, made the first major studio 3-D feature, "House of Wax." In order to present the film as effectively as possible it was filmed in the Warner-Color process and released in key engagements in WarnerPhonic (stereophonic) sound. Mr. Warner plans a full program of 3-D features for 1954.

by Jack L. Warner

ONCE AGAIN the motion picture industry has come to a fateful crossroads in its technical development. In this late spring of 1953 those who make motion pictures and those who operate the theatres are faced with the necessity of having to make bold decisions affecting the future progress of this vast and great entertainment business, which plays such a tremendous role in the cultural and recreational life of peoples the world over.

Scientists and technicians have given the creative artists new tools with which to express ideas—three-dimensional pictures, stereophonic sound and a variety of sizes and shapes in wide screens. How to utilize these many developments so that the art of film making can be advanced without causing serious dislocation, and, perhaps, ill-considered abandonment of proven techniques, presents numerous and complex problems.

Prophecy is not my business. I have no patience with the would-be seers who seem to have risen en masse within our business in recent months. To insist, as some have done, that from now on there can be only one method of making pictures is both foolhardy and dangerous because that kind of thinking eventually becomes a barrier to true progress. There is an open mind as well as an open door policy at Warner Brothers. We do not prejudge, we do not dismiss technical innovations on the basis of personal conceit or caprice. We approach decision methodically, after exhausting scientific analysis by our technical staff, which we believe is second to none. Similarly our production staff puts the invention under a microscope, as it were, to determine its practical and artistic usefulness, for every innovation or change must prove its relative merit toward the betterment of screen entertainment. Even so there is an element of risk in every decision, yet we believe ours to be a calculated risk because it is taken with a sound knowledge of available facts.

This was the kind of thinking that prompted Warner Brothers to take the lead a little more than a quarter of a century ago in introducing talking pictures. The revolutionary effect of "The Jazz Singer" on the motion picture world need not be restated here. Only the younger generation need be reminded that the historic date was October 6, 1927, or that the event which changed the whole course of the industry and opened a new era of prosperity, took place at the Warner Theatre in New York City. Less than a year later—on July 7, 1928, to be precise—Warner Brothers released the first 100% talking picture, "Lights of New York." The public was enthusiastic about the innovation. Yet there were numerous prophets within our industry who predicted that talking pictures would fade when the novelty wore off.

Today this industry is in much the same position as it was in 1927. There are two essential differences, however. The motion picture business is many times bigger and the art of film making has become more complex and expensive. Moreover, we are confronted today with a multitude of innovations. To say that any of them could match in magnitude the basic effects wrought by sound on the production of motion pictures would be a statement of false modesty. To ignore this fundamental truth would only lead to a distorted estimation of the gains to be derived from present and future technical developments. To view without perspective is to be like a prophet without honor.

By harnessing sound to the motion picture, Warner Brothers gave the medium a new dimension. Of all the current experiments in photography and projection, only stereoscopy can truly be said to give the screen still another new dimension. True depth and roundness in the images we see on the screen cannot be achieved by any of the wide-angle lens systems of photography and/or projection now known to us. These methods do enlarge the size of the image and occasionally result in an illusion of greater depth but the effect is neither three-dimensional nor consistent. To take advantage of the enlarged horizontal aspect of pictures obtainable through wide-angle photography it is certainly necessary to rescale the proportions of the screen so that it becomes more oblong in shape than square. But the effect here is limited primarily to changing the appearance of pictures.

The three-dimensional, or stereoscopic, film is quite another matter. This opens up a new avenue of expression for the film creator; an avenue, I might say on the basis of some actual experience, which offers tremendously exciting opportunities for stirring the emotions of the audience. And what is the sum total of all our effort if not to stir the emotions? In three-dimensional pictures we have a new key to unlock doors beyond which lie unchartered areas in filming and in stimulating reactions, both physical and psychological. But to progress in this direction it is necessary to have the cooperation of the audience in the wearing of polarizing viewers.

The success "House of Wax" is having with the movie-going public at the time of writing this article has convinced us that audiences will wear such viewers as effortlessly as they wear wrist watches or carry fountain pens. This was a discovery of vital importance because it must be remembered (and the fact cannot be emphasized too strongly in view of misleading claims about the three-dimensional illusion attributed by some producers to wide-angle photography) that it is scientifically impossible for the present, at least, to have three-dimensional film without the aid of viewers. Physicists and physiologists, with all the facts of optical science in their possession, cannot conceive the possibility of true three-dimensional film without a viewing accessory. By the end of the year it is likely that considerable improvement will have been made in the glasses to make them more comfortable and satisfactory to the public.

The principle of stereoscopic photography is more than a century old. Indeed its application to the motion picture excited the early pioneers of this business. However, science and technical know-how were not as advanced as they are today and as a consequence efforts then were directed toward the development of two-dimensional pictures. To be quite candid and factual, none of the techniques responsible for the current excitement, hope and confusion in the industry are fundamentally new. It is far more accurate to say that as creators of motion pictures we have come to recognize the existence of methods which will enable us to better achieve the proportions of a full symphonic expression via the screen. As far back as 1878, the year after Thomas Edison invented the gramaphone, Wordsworth Donisthorpe began experiments to combine sound and motion in pictures. Donisthorpe's dream was unfortunately greater than mechanical science, but from that day there persisted a fitful courtship between sound and image. Some fifty years later the marriage was happily consummated by Warner Brothers in cooperation with the Western Electric Company.

A higher wisdom apparently has appointed a few men to plant signposts along the path of human progress and, in so doing, has ordained that the initial steps should halt at a certain point to wait the passing of time and the arrival of others to go forward again. Thus, while the principles of three-dimensional film are old it can be said that the process is yet new for lack of exploration. We look upon "House of Wax" and our second 3-D picture, "The Charge at Feather River," as a means toward an end—not at all the end itself. We know from our continuing experience that three-dimension is another cinematic language. "The Great Train Robbery" paved the way for the story film; with the closeup D. W. Griffith introduced pictorial syntax; sound broadened the horizon of the screen and added a vital realism; color enhanced visual appeal. Now three-dimension, complemented by directional sound and color, literally enables us to give the spectator the thrilling experience of actually being a participant in the dramatic action.

Although Warner Brothers is an established company of long standing, we take pride in the fact that we have not lost any of the pioneering spirit which brought us to our position of leadership. We are proud to have taken the initiative among the major studios in exploring three-dimension. Because of our open mind and open door policy we were not prevented by false pride from taking advantage of the Natural Vision system despite the fact that, like other studios, we had experimented with our own three-dimensional camera system as long ago as twenty years.

The showing last November in Hollywood of "Bwana Devil" convinced me that the Natural Vision process was practical and with some refinement could be used immediately whereas there was a question of time regarding the bringing up to date of our own three-dimensional camera. Our showmanship instincts, combined with a sense of fair-play without which no achievement could be wholly satisfying, prompted us to make an immediate deal which we confidently expected would be beneficial to us as businessmen and rewarding to the Natural Vision Company for its efforts.

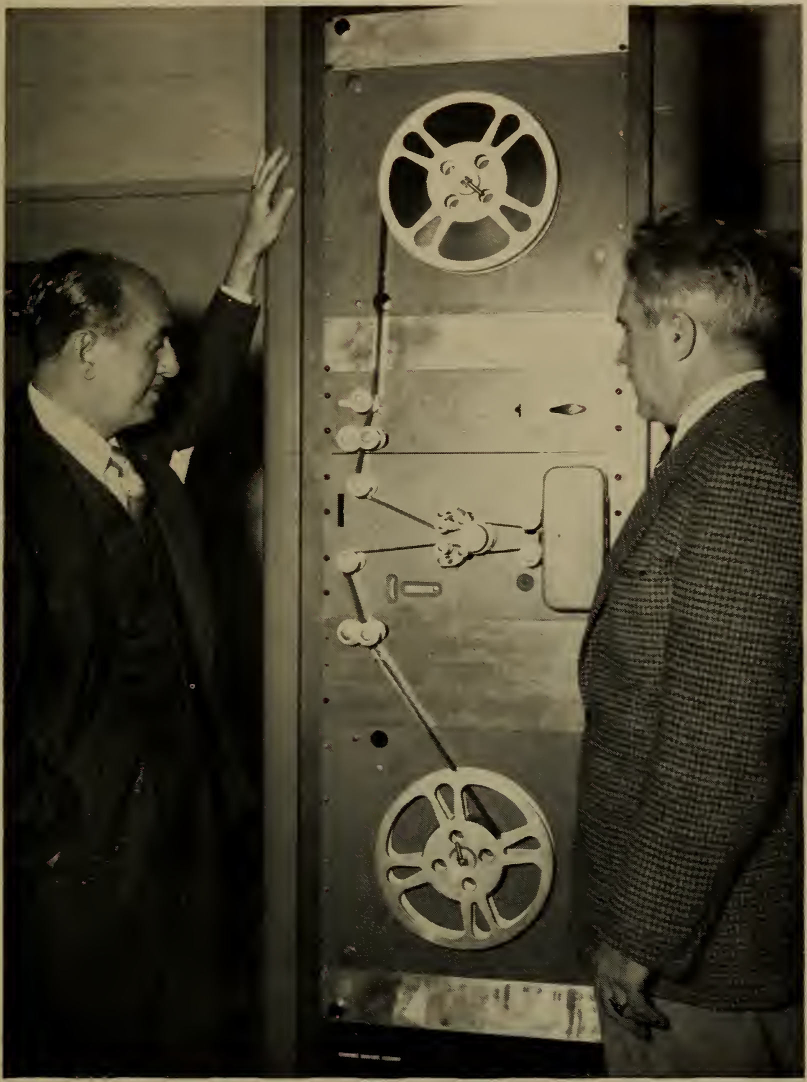
Meanwhile Warner Brothers technicians took our camera out of mothballs. This instrument, embodying the latest refinements in optics and some advancements which must remain company secrets until certain applied-for patents are granted—will be used to make our future 3-D pictures. At this time we have decided to use the camera on Alfred Hitchcock's version of the London and Broadway stage hit, "Dial M for Murder" and on the John Erskine book, "Helen of Troy."

The sudden burst of technical fireworks over Hollywood may well have caused many a newspaper reader to ask, "What was the matter with the studio technicians up to now?" or, "Have they been sleeping on the job?" Unfortunately it is the lot of the scientist to work quietly in the background. Always behind his moment of spectacular achievement there lies years of grueling, unsung effort. The high state of technical perfection of the modern motion picture is such that the non-professional is wont to accept it as having always been thus. We who spend our days in plotting movies, inspecting and analyzing pictures in projection rooms as they take form frame by frame and foot by foot and have to be concerned with the quality of the recorded voice, the integration of sound effects and the recording of musical scores know differently.

Many costly and patient experiments, via the trial and error route, stand as mute testimony to the progress we have made in the use of sound. Perhaps we have the attitude of a doting parent, which would be understandable, but it always has been the conviction at Warner Brothers that somehow sound, although having attained its majority in point of years, had not acquired its rightful maturity of expression. Our first determined efforts to enhance the dramatic use of sound resulted in the introduction of Vitasound in 1940. This method for spreading the source of sound was tried out in "Santa Fe Trail" and "Four Mothers." A control track printed in the sprocket-hole area of standard release prints was employed to operate a variable-gain amplifier to secure the increased effective volume and to operate a loud speaker switching relay for extending the source of sound to loud speakers beyond the screen. The Strand Theatre in New York and Warners' Hollywood Theatre were equipped with extra speakers thus to spread the sound. The time was not ripe, however, for extensive experimentation as both men and equipment were called in steadily increasing number to fight for their country's future.

Our present WarnerPhonic sound, which was introduced with "House of Wax," is a big brother of VitaSound. Its superior tonal quality became possible with improved recording apparatus now in use at the studio and the development of magnetic recording. WarnerPhonic sound makes use of three tracks in addition to the single track on the film. With a total of four sources for sound it now is possible for us to pinpoint the sound at its source as action transpires on the screen. We also can spread the sound around the theatre so that it will come from either side or even from behind. For the first time we have complete mobility of dramatic action with sound and we believe that the WarnerPhonic system is a step in advance of other methods of stereoscopic sound.

Warner Brothers also is proud of its development and perfection of Warnercolor which utilizes the Eastman single strip color negative. The first picture that used Warnercolor, "The Lion and the Horse," released in 1952, was favorably compared



STEREOPHONIC *magnetic sound reproducer is checked by Jack L. Warner, vice-president and executive producer, and William A. Mueller, chief transmission engineer, at the Warner Bros. Pictures studios at Burbank, California.*

with Technicolor. We have made considerable progress since then and there was high praise by the critics for the quality of Warnercolor in "The Miracle of Fatima." I might say that we were flattered, and annoyed by the lack of credit, when *The New York Times* thought that we had used Technicolor instead of Warnercolor on "House of Wax." We are steadily expanding our laboratory facilities and within a period of time will be able to take care of practically all our color needs in our own studio.

One of the great advantages of Warnercolor is the speed with which it can be processed. When a director shoots a scene today and wants to see it tomorrow in color he can do so, for Warnercolor can be processed as quickly as black and white film. Having our own color process gives us greater flexibility in operation because we don't have to stand in line or otherwise compete with other studios in scheduling the production of color pictures. The speed with which we were able to produce "House of Wax" once the decision was taken to do the picture in three-dimension provides a striking example of the advantage that Warnercolor affords us.

You may be wondering why I have not gone more deeply into wide-screen photography and its possible effects on this industry. Well, Warner Brothers was over this course in the distant past, too. We used a wide-angle 65mm film for "Kismet" (1930), with Otis Skinner, and in making "The Lash" (1931), with Richard Barthelmess. But we went back to the production of normal size pictures for the simple reason that the public apparently wasn't prepared to get excited enough to make our efforts at expanding pictorial scope worth while.

Of course, the addition of the sound track to film—in our first talking pictures the dialogue and sound was recorded on separate disks—narrowed the space available to photography. We are now obviously trying to get back some of that space in order to increase the horizontal dimension of the screen, but the old battle between the director and the sound department is by no means over. With big screens, measuring anywhere up to eighty feet in prospect for some theatres, it becomes almost a necessity to employ directional sound and that means adding at least two more sound strips on each negative. The most desirable arrangement is to have all the sound sources on the picture film but to do so means to take away some of the space available for photography.

While I have confidence in the staying power of the three-dimensional film, I do not contend that it will be the one and only means of pictorial expression for the future. I believe it is very likely that films will be made in a number of different forms, depending on which is most desirable for a particular type of story. And I believe that it is quite possible that a number of the techniques causing so much excitement and uncertainty at the moment may be comfortably used in combination. For instance, the three-dimensional technique can be adapted to accommodate the wide-screen. "Helen of Troy" is a subject with sweep which might well be suited to a combination of three-dimensional and wide-angle photography.

Already there have been calls for an immediate standardization of a certain process for the industry. That would be disastrous, for if there is one danger among all others which this business should strive to avoid that danger is standardization. This is a business built on ideas and feelings and there would soon be very little imagination left if a particular method of making pictures were to be rammed down the throat of the industry. To me that is just as ridiculous as saying to a great artist that he must do all his paintings within a standard size frame measuring two feet wide by one foot high.

However, it should be possible to develop a genuine all purpose theatre screen so that the exhibitor won't have to start remodeling his theatre for every picture he plays. Such a screen could be masked on the sides and top and bottom for the showing of standard-size pictures and the full area of the screen could be used for exhibition of wide-angle pictures. Its surface would be coated with a high intensity light-reflecting material so that three-dimensional pictures also could be shown without loss of picture brightness.

The theatre operator as well as the producer has a greater responsibility because of the many new developments now known to us and others which may well come to attention tomorrow. It is of paramount importance in the case of directional sound that control volume be maintained at an agreeable level for the size of the house and not turned up so as to deafen the audiences. And in the case of three-dimensional films, there must be constant vigilance against possible mechanical disturbance in one of the two projection machines which might cause the film to waver or have some even more disastrous effect on the alignment of the images.

It is not enough to make a picture as near perfect as possible at the studio, if it is not going to be shown under the most ideal circumstances. Whatever progress is made in Hollywood must be matched by like progress in the art of exhibiting motion pictures. And make no mistake about it, the proper presentation of movies calls for a sense of artistic appreciation as well as plain, old-fashioned business acumen.

The "House of Wax" Campaign

NO MATTER how excellent a picture may be it is made to be seen by millions and the public cannot be expected to see a picture it has not heard about. Characteristic of many of his fine advertising and publicity campaigns — with points that may be applied in other situations—is the work for "House of Wax" of Mort Blumenstock, vice-president, Warner Bros. The problems were unique and the results at the box office were excellent.

by Mort Blumenstock

BY GIVING the motion picture screen a new proportion, 3-D has likewise given motion picture advertising a new dimension.

It has freshened the most important element any advertiser can bring to the creation of advertising, the real spirit of selling in any medium. This is the element of enthusiasm.

There are many attitudes a wise advertiser can give to his texts and his displays. But freshness, born of natural enthusiasm, seems to have a contagion that has always gotten it home first to the terminal point of actual sale.

In a business, more than any other, that has been endowed with glamour, physical attractiveness, and worldwide opportunities for enhancing its pitch to the public, motion picture advertising now has a tested and proven ingredient in the expression

"3-D" which the public has accepted in this condensed and easily usable form and which has begun to be part of the language.

As Americans, we know ourselves too well to think for a moment that anyone is going to speak about "the stereopticon third dimension" when all one has to say is 3-D. Likewise in England, where the stereoscope, the first 3-D picture viewing device was invented in 1838, American motion picture advertising and publicity have helped the British, in their fondness for alphabetical tags, to telescope "third dimension" into its compact and easily mouthed initials.

This enthusiasm for the word, the process, and its possibilities for promotion, was generated last October in Burbank in a conversation with Mr. Jack L. Warner when he told a few of us at the studio that he was organizing a unit to make the first all *3-D production* in the history of the motion picture business.

The process had been known in the industry for many years. Experiments, including some in our own technical laboratory had not been too encouraging. Mr. Warner felt that a major effort combining the 3-D camera process and the stereophonic or WarnerPhonic method (four sound tracks instead of one) which Warner Bros. had been perfecting over a period of years and our WarnerColor process might well be the combination that would capture public approval.

Mr. Warner had come to a firm conclusion. The same conclusion that he and his brothers reached in 1926, when they had rejected all the sombre warnings that talking pictures "won't work," "won't pay," and then turned the amusement business upside down with "The Jazz Singer."

He selected the story of "House of Wax" because it was perfect testing material for third-dimension camera, sound and color.

What went into the advertising plan for attracting more people into this country's theatres than our box offices have recorded in over twenty-five years was mainly the same optimistic Warner philosophy that went into the actual making of "House of Wax" . . . "If it is handled right it can be very right."

As this is written "House of Wax" is proving very right with theatre attendance records from coast to coast mounting into figures that may well add up to the biggest grossing production ever made and distributed by Warner Bros. Pictures.

Our advertising theme was prepared for us by the technical phases of the motion picture itself.

With a firm basis for theming our advertising and publicity we also had a timetable and a deadline, April 10, 1953, the world premiere date at the Paramount Theatre in New York.

Our publicity was being serviced to the newspapers and the trade papers by the studio press staff in Burbank, and the home office publicity department in New York. Our field publicity men in Boston, Washington, Atlanta, Jacksonville, Dallas, Oklahoma City, St. Louis, Chicago, Cincinnati, Denver, San Francisco and Toronto were in contact with the motion picture departments of all the newspapers in their districts to fill the special requests for stories, photographs and technical information. This material had been furnished to our men in portfolio form as early as December, 1952. And we supplied them with every new detail of production as shooting got under way, January 19, 1953.

There are many "firsts" in the advertising and publicity records of "House of Wax."

It is the first time we were ever called upon to appear knowledgeable in technical mysteries. Our field men, and our two main publicity offices, were almost swamped answering questions on stereo camera lens functions, bringing new words into our copy such as "point of convergence," "aspect area" and "molecular condensation of emulsion." Students of M.I.T. and Cal-Tec could not have written and spoken this very special laboratory lingo with greater assurance than we did. All of us glibly used three engineering phrases which are supposed to be kindergarten for the men who are blueprinting the things to come in the field of 3-D and creating new illusions within the human "optical periphery." But for many writers and receivers of motion picture copy, something new had been added. Part of every field man's portfolio for "House of Wax" was a pamphlet of required reading on stereopticon research. Early press returns show that the Warner field men must have given this book more than one reading.

Our advertising approach to "House of Wax" which we began to put on paper as early as December, 1952, started with the perplexing problem that required us, for the first time in the annals of the motion picture business, to set before the public in flat two-dimensional advertising surfaces a convincing and reassuring proposal to pay its way into the theatre and see the third-dimension process "as it should be seen."

Too, we had to wonder, until "House of Wax" began to play, how much damage there might have been done by some early 3-D pictures creating public resistance and coolness to the medium which would find us trying to merchandize a finely made production in large areas of complete indifference.

This kind of fear can be stimulating to an advertising group. In our enthusiasm, which was fed by every day's results on the shooting stages, we believed that the public would accept and respond to advertising which said in simple language that "House of Wax" is "3-*D as it should be seen.*"

With only flat two-dimensional stills, which looked like every still we had always seen, the words which spoke most illustratively were: "Every scene comes off the screen . . . right at you!" So this became a part of our text in nearly every advertisement. It sounded right as we said it, and we were sure it would read right.

Most of the copy which became part of our ad pitch came out of natural conversation in staff meetings when we found ourselves talking about selling angles dealing with a picture made in a medium that was brand new to all of us.

We enjoyed the experience of working on the first important picture of its kind in the history of the advertising business. We felt "House of Wax" should be introduced to the public by advertising that said: "The first picture of its kind from a major studio." We wanted the campaign to have the significance and recognition that attaches to the name of Warner Bros. as the pioneers in the introduction of talking pictures.

Finding the illustration to trademark our campaign, was again a matter of realizing that conventional two-dimension still photographs could not give the public the real meaning of what happened in our picture when 3-D was used to its fullest effect.

Our copy described the illusion, "Beauty and terror meet . . . in your seat." In order to put this same force and perspective into flat printing, we posed professional models with "under camera" angles that gave the theatre audience view of "the man turned monster who craves the show world's beauties for his chamber of horrors."

By undershooting our "monster," and a single girl whose high kicking pose was duplicated into a line of precision dancers, we finally arrived at the composition which has become our recognized trademark for this picture: Girls and Monster seemingly pouring out of a forced perspective motion picture screen, over the heads of a theatre audience. This was 3-D!

We now had the right blending of illustration and copy that gave the required validity to the advertising language which said in plain bold type "every amazing scene of its sensational story comes off the screen . . . right at you."

If a study of our advertising and accessories brings the question, why wasn't the monster more fully revealed in the illustration, it should be recorded we were not dealing with any ordinary monster. Our screen monster in the "House of Wax" was wearing makeup that took about three hours to prepare, and represented the burned and welted face of a once normal sculptor who lost his features and his sanity when his museum was burned by a villainous arsonist hoping to destroy the sculptor and his creations in a roaring holocaust.

The makeup worn by Vincent Price will probably go down in the history of the motion picture business as the most evil looking and terrifying makeup seen on the screen since the first "Dr. Jekyll and Mr. Hyde." With the burns and welts of the man's features treated in the realistic tints and tones of WarnerColor, it was something an experienced advertising sense told us to save for the theatre itself. We could never hope to make a black and white page set forth our "Monster" with any part of the wallop that he packs on the screen.

One of the few motion picture companies that continues to make and distribute its own screen trailers, we again ran head-on into a logistical condition that was partly technical or partly mechanical within the exhibition field. We knew that only a certain number of theatres were equipped with 3-D projection apparatus and that certain numbers of theatres had the equipment on order but not already installed. If we were to make our trailer in 3-D, it would never have been shown. It would have meant the setting up of the theatre projection equipment four or five times a day; every time the trailer was to be seen. The interlocking device of the two projection machines requires more than an hour's work and a few minutes of test run to be sure that both right and left projectors are synchronized. In the regular operation of a continuous run theatre playing standard two-dimension feature pictures it wouldn't and couldn't be done. And the current market was ninety-nine per cent regular two-dimension pictures. So we created a paradox, advertising the power of three-dimensional dramatics with a two-dimension trailer.

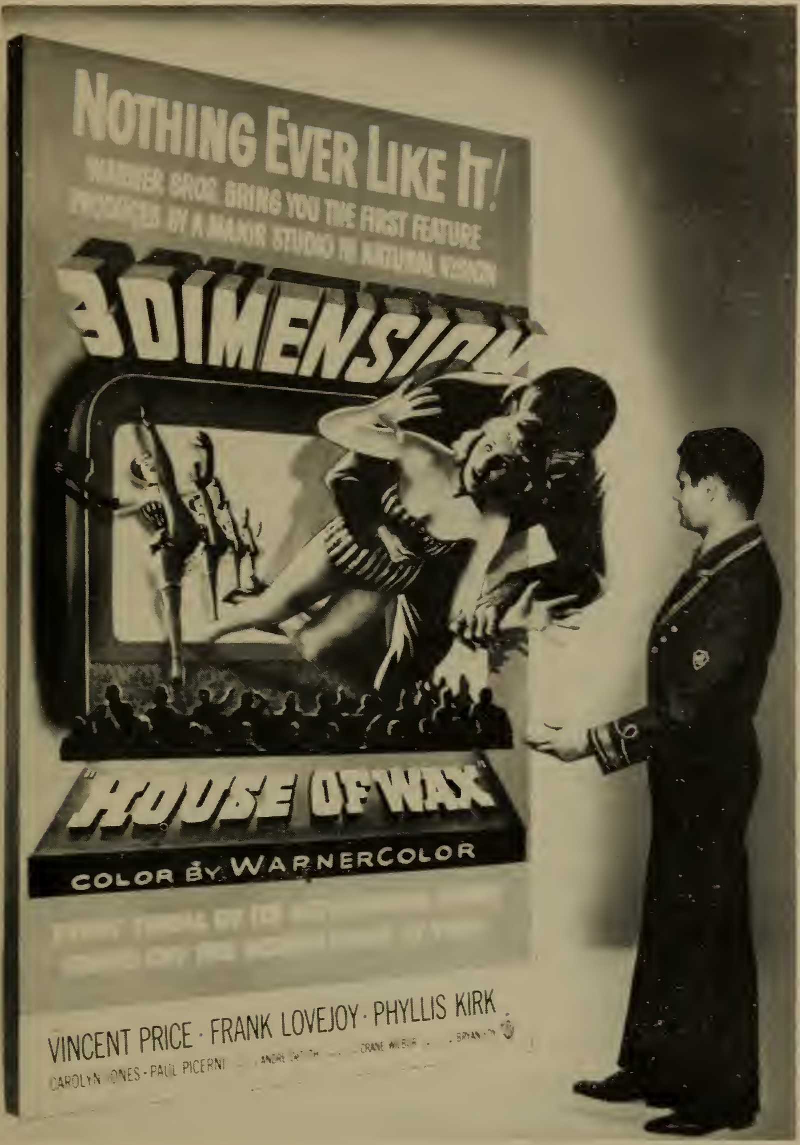
We made a handsome and complete "text" trailer. For illustration the title backgrounds were treated in a series of smart impressionistic sketches supporting the copy; and copy was keyed to the newspaper ads. The success of this all-important accessory was assured because we were able to give the trailer rich WarnerColor backgrounds, and a music score that said as strongly as the copy lines that there was really something special and quite revolutionary to be seen in "House of Wax."

Besides our trailer, the first of its kind to service theatres in the United States and abroad, we had to create, as the medium demanded, the first lobby display with 3-D effects.

Once we had decided on the important illustrative trademark of Girls and Monster, we began working on the construction of a lobby piece that would set forth the three-dimension effects in full color with no limits set on any size or proportion except the simple economic governor that we knew we could not make these for free distribution.

Long experience in the needs and budgets of our theatre accounts told us that for widest possible distribution, imagination and reality had to come to a juncture point somewhere under $20. With careful giving and taking in the matter of production costs we finally were able to set up an outstanding lobby piece with our Monster and the Dancing Girls coming out of a theatre screen, under a headline in ringing lithograph colors: "Nothing Ever Like It."

The advertising headline on the top of this lobby piece is a


NOTHING EVER LIKE IT!
WARNER BROS. BRING YOU THE FIRST FEATURE PRODUCED BY A MAJOR STUDIO IN NATURAL VISION
3 DIMENSION
"HOUSE OF WAX"
COLOR BY WARNERCOLOR
VINCENT PRICE · FRANK LOVEJOY · PHYLLIS KIRK
CAROLYN JONES · PAUL PICERNI

THREE-DIMENSIONAL lobby display piece designed to promote "House of Wax."

fair estimate of its display value in the theatres. Its sale is now in the thousands, with production in a close race with orders.

For our earliest dates, New York and Los Angeles, premiere activities were taken fully in hand by the New York publicity and advertising department, working with the New York Paramount staff for the April 10 world premiere.

In Los Angeles, the studio publicity department was at work with the staffs of the two Paramount theatres booked to open April 17.

In New York we tested our first full large scale television campaign for this engagement, supplementing a big newspaper buy, using nearly two hundred one-minute "spots" and the same number of twenty-second "spots" spread through eight days before opening. An important part of the New York campaign was bringing into New York the stars of the picture, Vincent Price, Frank Lovejoy, Phyllis Kirk and Paul Picerni. Their press interviews were many, as this was the first group of actors who could report on what the third-dimension required of an actor. Radio and television producers engaged them for many appearances.

Magazines were beginning to appear with "House of Wax" articles at the time all the newspapers, radio and television interviews were pointing to April 10.

At 8 A.M., April 10, with the box office opening at the earliest hour in the 26-year history of the theatre, it was possible to forecast that in spite of miserable weather we were on our way to the all-time non-holiday opening gross. Our early morning prediction came from one of the policemen in the big squad that was helping to keep order around the box office.

In Los Angeles, a week later, another first was added to the promotive log of "House of Wax" when it opened at the Paramount Theatre in downtown Los Angeles with a Premathon opening—a combined premiere and marathon schedule of performances—beginning at midnight, April 16, running through the full twenty-four hours of April 17 to provide Los Angeles with a brand new kind of premiere in the town that claims all patent rights on how to give a motion picture a glitter and glamour debut.

The Premathon was the result of idea-swapping by the Paramount Theatre organization and the Warner studio publicity staff. Every performance was a dedicated premiere. Something very new.

12:00 Midnight — Spook Premiere
2:00 A.M. — Aircraft Swing Shifters' Premiere
4:00 A.M. — Milkmen's Matinee
6:00 A.M. — Breakfast Premiere
8:00 A.M. — Career Girls' Matinee
10:00 A.M. — Civic and Press Special
12:00 Noon — Luncheon Club Rally Premiere
2:00 P.M. — Housewives' Jamboree-and Shoppers' Special
4:00 P.M. — School Matinee
6:00 P.M. — Shop Girls' Premiere
8:00 P.M. — Screen Stars' Premiere
10:00 P.M. — Daters' Premiere

More people came to the theatre than had ever before filled its seats since the first day it opened for business.

In Dallas, Houston, San Antonio and Fort Worth, the Texas Interstate Circuit opened "House of Wax" with their biggest combined newspaper and television advertising campaign to receipts that looked as though the third-dimension process was a kind of apparatus for producing oil without breaking the crust of Mother Nature's very special Texas gusher grounds.

San Francisco and Boston opened on the heels of twenty-five big cities from coast to coast. We haven't varied the campaign, in any instance, except to provide special copy for those theatres which were able to install WarnerPhonic Sound; described in our copy as "the wedding march of 3-D sound and 3-D camera."

We are learning many things as "House of Wax" continues to set its record-breaking pace in every theatre thus far played in the United States. All of which will benefit our approach to the promotion of our next all 3-D production, "The Charge at Feather River."

We are looking forward to the first reports from Paris, Rome, Sydney, Manila, Hong Kong and the big cities of Mexico and South America, all of which have now realized that "House of Wax" has an important front door where old man opportunity has tapped loudly, for the whole amusement world to hear.

3-D in Theatres

EXHIBITION of 3-D features posed a new problem to theatres and James Brigham as theatre engineer for the Natural Vision Corp. was the one called upon to find workable solutions. From the time he was in high school Mr. Brigham has been a motion picture projectionist. He has worked on projection and sound in many theatres and a number of the principal motion picture studios in Hollywood. When "Bwana Devil" was ready for showing he traveled widely in the U. S. as a consultant.

by James Brigham

THE DEVELOPMENT of 3-D today has followed the line of reasoning that the two pictures required to be projected upon the theatre screen be kept as two separate pieces of film. There are several reasons for this: one is the added light needed; another is the added magnification needed and the resulting loss of definition if two pictures were divided within one frame. At any rate, the path followed up to the present time is two pictures projected upon metallic or aluminized surface screen and polarized as they are projected so they may be separated at a point just in front of the theatre viewers' eyes by the use of polarized glasses worn by the viewer.

The problems of projecting 3-D are not too great. The first thing that must be done is to interlock the two projectors to keep them running frame for frame upon the screen. This can be done either mechanically or electrically. The industry is beginning to accept only the electrical method which employs the use of Selsyn motors coupled to the regular drive motors of the projectors. The Selsyn motors keep the machines in step and do not do any work other than to keep the machines from drifting apart.

The electrical method of interlock is the Selsyn motor. To describe it simply, it is a rotary transformer.

The primary is a single coil wound on the armature, and the secondary is a set of three coils wound in the frame and connected in the shape of a triangle.

As the rotor is turned, voltage is raised or lowered in each coil as the rotor changes in relation to the position of the field coils.

If two of these motors are connected in parallel, they will assume a position where no current will flow, which will be exactly the same for both motors. If one motor is turned, the other will turn to the same position until no current will flow.

We are still using the regular drive motors to run the two projectors, but we are now coupling two Selsyn Motors, one on each machine. These will keep the regular drive motors from drifting apart. If one drive motor has a tendency to lead the other, due to a difference in load (stiffer projector), the leading Selsyn will pull the lagging Selsyn ahead.

This Is a Tight Lock: The Motors Will Turn Together Turn for Turn

The continuous operation of the two projectors means that the lamps must be kept burning on both machines constantly during projection of the 3-D picture, which in turn means the D.C. supply to the booth must be adequate for double the load it carried previously. A large portion of the theatres have stand-by generators or rectifiers which take care of this problem. Theatres without this extra source of D.C. supply will have to increase their generators or rectifiers for a continuous double supply.

The greatest basic change in the projector equipment—since we are using two projector machines at the same time (unless there are four projectors in the booth, which would only be found in class A theatres in large cities) is that the show must have intermissions to allow time to thread the machines and retrim the lamps.

Use of the standard 18-inch magazine would mean that a feature would have three or four sections which would require the same number of intermissions. It was found that large magazines could be used and thus mount a show of 90 to 100 minutes in two sections with but one intermission for the feature plus two more intermissions for the entire show. This type of show would take place in two machine theatres. Only one intermission is necessary in a three-machine theatre. At the time 3-D was first developed for feature presentation there was on the market a projector magazine of 24-inch inside diameter. Using a 23-inch reel, a show of 90 minutes or more could be run with one intermission. In field practice it was found that another inch in diameter of the magazine was desirable to allow for handling of the reel when full of film as well as allowing for a larger reel in case of longer features. All new magazines are coming out in 25-inch diameters.

Another problem that has to be solved is the burning time on the trims of carbons to carry a section of film of 45 minutes or more. About 85 per cent of the theatres in the country are equipped with Suprex type lamp houses which burn a copper coated non-rotating carbon. Although the carbons are made in 14-inch lengths some of the lamp-houses only have an 8- or 10-inch carriage distance. In other words, they can only take an 8- or 10-inch bite on the carbon before it has to be shifted. (We found we could establish a 45-minute section using 68 amps on a 9 M/M Positive carbon of the Suprex type.)

Now I understand there is on the market a type of water-cooled combination heat baffle and carbon jaw that keeps the carbon cool and carries the current out to the end of the carbon, which consumes less carbon and allows for higher amperage per trim time.

The burning time has never been a problem on the high-intensity type of lamp-house that uses a black rotating carbon of 22 inches in length, as these carbons feed through to the end of the carbon.

The projectors must have a common switch on their separate drive motors to allow them to be started simultaneously from one position. In a two-machine booth this switch usually is placed between the two machines on the front wall and the projectionist on the left hand machine has the control of the starting and stopping of the two machines when they are coupled together for 3-D. Also, in this position he is able to close both hand dousers on the lamps in case the machines have to be stopped in a hurry because of trouble, such as a break in the film. The switch for the Selsyn electrical interlocks is usually placed close by the master 3-D switch. In a booth having three projectors, two of the three machines are picked to be the 3-D equipment, and the third machine is used for shorts or for starting another feature if the theatre is showing a mixed bill (2-D and 3-D). This third machine eliminates another intermission that would be necessary at the start of a 3-D feature.

One of the basic factors of 3-D today is the use of the polarizing filter through which to project the picture from the booth and with which to view the projected picture on the screen.

The polarizing filter might be likened to a microscopic venetian blind where the slots are too small to be seen other than with a microscope. If the picture is projected through a polarizing filter and the projected picture is viewed through another sheet of polarized material the axis of the slots must be in the same direction for the viewer to see the projected picture.

Two pictures can be projected upon the same screen and by having their axes at right angles or 90 degrees to each other they can be viewed through corresponding aligned filters and only the picture meant for each eye will be seen by each eye. The projection port filters are mounted so that the axes are 45 degrees outward from the vertical, the right-hand filter being rotated 45 degrees from the vertical to the right, and the left-hand filter 45 degrees from the vertical to the left thus making the 90 degrees between their two axes.

The filters come in sheets and are cut so that if the top edge is leveled with a small spirit level when they are originally mounted in the booth they will be correctly aligned and will match the viewing glasses.

The development of 3-D to date has been to adapt as much of the present booth equipment to the use of 3-D as possible. Basically the only additions are large film magazines for the projectors and a method of interlocking two projectors to run frame-for-frame. Extra switches and the mounting of polarizing filters are fairly simple operations.

The mounting of large magazines (24-inch and 25-inch) upon the present projectors presents the most difficult problem. As a general rule the more new and modern a projection booth is, the easier the job of mounting the large magazines becomes. This is because the minimum size of the booths has been increased in all the building codes throughout the country. Many require doors on opposite walls and at least two to a booth. Wiring codes have also been standardized.

The first installations of large magazines meant that the projectors had to be moved back from the front wall to permit clearance between the top magazines and the front wall. In some of the projection booths in large metropolitan towns, where the theatre had been originally a legitimate house, the booths did not permit moving back of the machines due to the small size of the booth, as well as the steep angle of projection. Thus an angle bracket, to straighten the magazine, as well as an extension bracket to clear the lamp-house, was developed. These brackets are in extensive use in and around New York.

With the large magazines mounted and the interlock installed, and polarizing filters mounted in the projection portholes, the booth is set up to run any 3-D film that uses the two film strip method, the only one in extensive use today. Again it will be observed that only the present equipment of the projection booth has been used or adapted to convert for 3-D.

After the equipment of the booth is installed, the two projectors must be lined up on the screen. This is done by threading two line-up chart loops in the machines. These line-up charts are regular 35mm film on which has been printed on a black background a set of horizontal and vertical lines spaced apart to form a checker-board pattern. It will be seen that if the pictures projected by the two machines are superimposed over each other on the screen any discrepancy between the two machines such as their not being level will show up because the horizontal lines of the line-up charts will not lie on top of each other from one side of the screen to the other side.

Also if the machines are not correct horizontally the vertical lines will not blend into one line. Often the two projection lenses, although marked the same in focal length, will be slightly different. This would not be noticed if a lineup procedure was not followed.

In case one picture seems to be slightly larger than the other —the machine must be leveled with the horizontal lines of the chart and the center vertical cross-line superimposed permitting the discrepancies to fall to the outside of the screen. After this is done, the polarizing filters are mounted in the projection ports and the machines are ready to be threaded with the regular 3-D film. Care must be taken to be sure to put the right-hand film or right-eye film in the right side projector and also that the right-side polarizing filter be placed in the right side part, and the same with the left side. Care must be taken to thread the two projectors at exactly the same frame on each piece of film.

If both machines were interlocked with the shutters straight up and down, and the intermittent movement just turned to the locked position and the same frame threaded in each machine the pictures would be in synchronization when projected on the screen.

After the two pictures are on the screen one of the machines should be framed either up or down until the horizontal lines of each picture are in line across the screen. This leveling should be done with only one machine. Practice usually leaves this to the left-hand machine or the machine that has the master 3-D switch beside it. This leveling should be done on foreground objects and without the use of polarizing glasses to allow the operator to see both pictures.

Having done this, projectionists are instructed to put on polarizing glasses which are beside each part and are marked for use at that position only. The special glasses are made up from standard theatre viewers by the operators but they have two left or two right windows in them depending upon which machine they are beside. These enable the projectionist to see only the picture projected by his machine with both his eyes, and he will then be able to focus his picture sharply. After the picture is in sharp focus the special glasses should be removed.

In actual practice the operators do a better job if they do not use the glasses at any time other than to focus the picture.

Light balance between the two machines is checked when they are running by looking at the screen through one eye-piece of a pair of regular polarizing glasses and then shifting quickly to the other eye-piece.

If a break occurs in either the left or right reel, a number of frames of black leader must be inserted equal to the number damaged and removed to keep the proper synchronization between the two reels.

If a film should break during a running, the machines must be stopped and rethreaded on new start marks within the reel by either using the first frame of the next scene on both reels or locating the same frame by using corresponding edge numbers printed on the film.

Screens for 3-D reproduction have a metallic surface. All those in use today use an aluminum coating. This is to reflect the light and picture without breaking up the polarization of the light that has been accomplished by the use of polarizing filters in the projection port-holes. A plain aluminum surface is very highly reflective and would only be good for a long narrow theatre. Since this is the exception rather than the rule the screens have to have an aluminum surface but it must be broken up slightly but evenly to distribute the reflected light to the sides and to the balcony of the average theatre. This can be done several ways, either with just a plain roughened surface or with a careful pattern of lines or figures embossed upon the surface under the aluminum coating.

Summing it all up, *good* 3-D can be reproduced in any theatre at moderate cost providing the theatre has at least two good projection machines.

PART II

Wide Screens

- **Cinerama**
- **CinemaScope**
- **Other Techniques**

[*Aspect ratios from 2.0 to 1 to 1.66 to 1*]

SCREEN ASPECT RATIOS

The aspect ratio is the relationship of the screen's width to its height. The rectangles on this page show the proportions of the variously shaped screens.

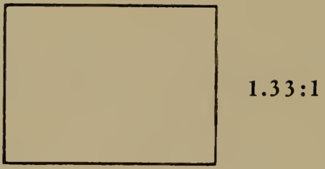
At the top is the traditional standard, 1.33 to 1, established in 1888 in the laboratory of Thomas A. Edison.

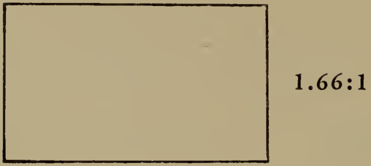
The second, 1.66 to 1, is the size recommended by Paramount, achieved by "cropping" the images 10% top and bottom.

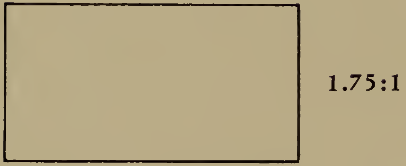
The third, 1.75 to 1, represents the widest screen possible, without changes in camera technique.

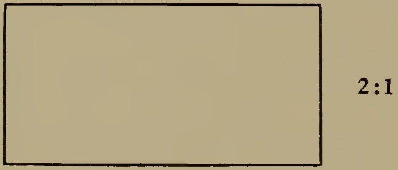
The fourth, 2.00 to 1, may be achieved through the use of guide-lines in the camera viewers or through a compression-expansion lens system. The fifth, 2.55 to 1, is the CinemaScope screen.

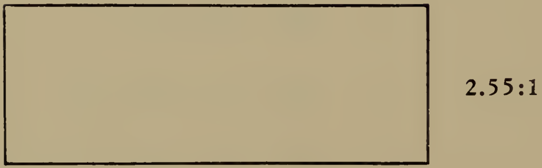
The sixth, approximately 2.85 to 1, is the deeply curved Cinerama screen.

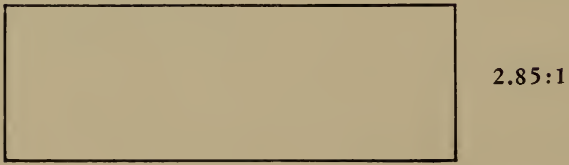












CINERAMA

The Birth of an Idea

AN architect had a unique conception of a building for a client at the World's Fair of 1939 in New York. That concept had a profound influence on the evolution of what became known as the entertainment wonder, Cinerama. The story is told by the architect himself. Ralph Walker is well known in his field for many imposing structures, including telephone company buildings and oil research laboratories. He is a member of the firm of Vorhees, Walker, Foley & Smith.

by Ralph Walker

I THINK I SHOULD say at the very outset that this brief article is in no way intended to detract from Fred Waller's impressive originality of thought and surely the no less impressive persistence that has culminated in the successful presentation of his Cinerama. But inventions of this kind never spring fully-developed from one mind alone, pondering in splendid seclusion. They are the result of years of toil, of trial and error and trial again. Often the difference between success and failure is the discovery of a single clue, a key that unlocks the entire riddle. Waller and I had the good fortune to meet at a moment when I happened to be carrying just the key he needed.

For some years Fred had been trying to impart to films a complete illusion of reality. From his background in special effects photography, combined with his innate genius for all things photographic, he had been approaching the problem from the direction of the wide-angle lens and multiple images on an extra-wide screen. Through actual experimentation he had arrived at the conclusion that much of our perception of depth is based in fact on what he calls "peripheral vision," those fleeting glances we catch out of the corners of our eyes. The obstacle, the stumbling block in the way of attaining peripheral vision on an ordinary wide screen was the fact that such a screen, to provide all the environmental details required to complete the illusion, would have to be the width of a city block. But all of his experiments had been upon the ordinary, flat screen, the screen that had been universally accepted as standard until the advent of Cinerama.

As an architect, I had been concerned with a remarkably similar problem for a number of years before we met. In 1929 I was commissioned by Curtis Bok, the Philadelphia philanthropist and patron of music, to draw up plans for a new auditorium, an ideal theatre for the presentation of symphonies and opera. To me this was an exciting challenge. All too often such an assignment is hedged about with all sorts of restrictions—usually, getting the maximum number of chairs into the minimum amount of space. Here, on the contrary, I was asked to create an auditorium the only specifications for which were that it provide the finest acoustics and the best sight lines possible.

I began by making a study of existing theatres, both here and abroad. Repeatedly, I climbed up on the stage to see what the actors saw, as well as into the top balconies to get the audience's view—or, not infrequently, lack of view. I spoke to theatre people like Roxy, to musicians like Stokowski, and to numerous ordinary theatre-goers like myself. And gradually I came to think that almost all auditoriums have been constructed backwards. Most theatres are built like a megaphone, the mouthpiece at the stage, the widest part at the rear of the hall. Instead, I began to suspect, the plan should be just the reverse, with the widest part of the house being the stage itself and the seats banking up in gradually narrowing tiers.

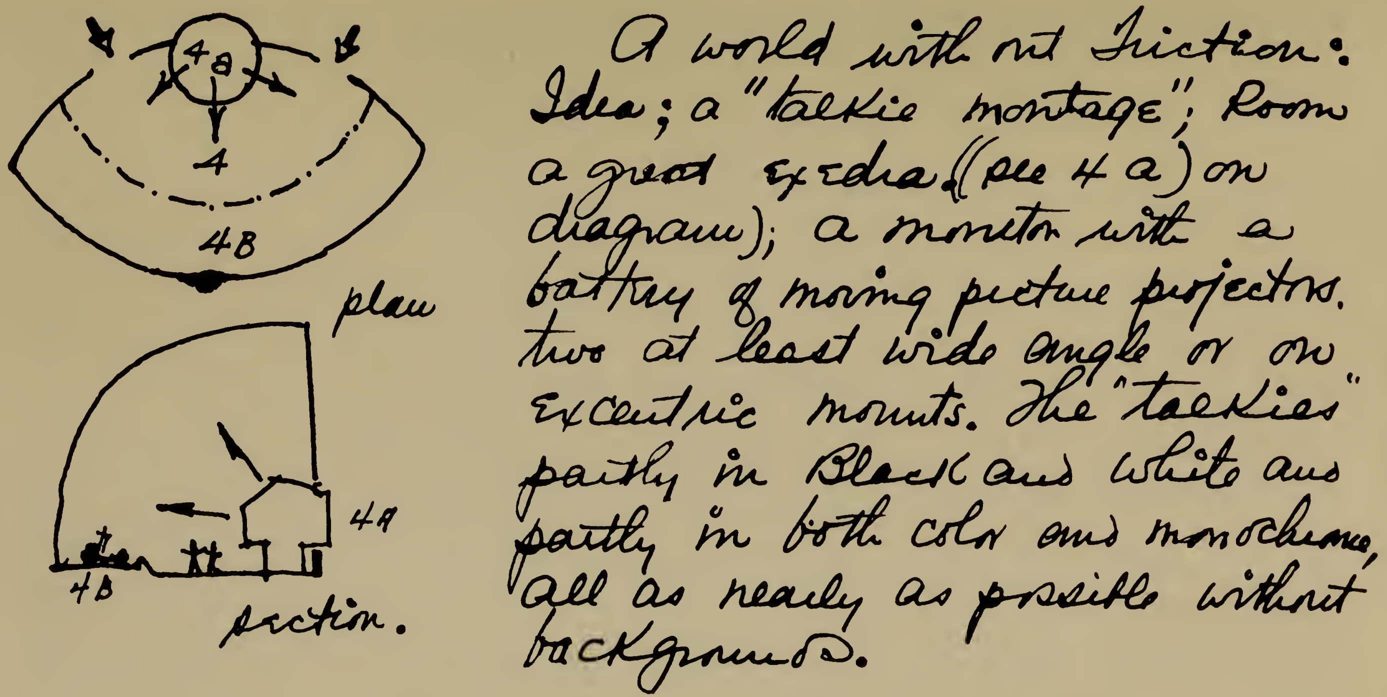
I reached this conclusion after, like Waller, I had studied the special characteristics and requirements of the human eye. I too had noticed the importance of peripheral vision in giving a sense of depth and perspective even to live action on a three-dimensional stage. I noticed how the downward sweep of the conventional proscenium cuts into the spectator's line of vision, reducing the illusion built by the settings of a play. I saw too that the conventional stage, with its slight tilt to provide a better view for the customers in the orchestra, was actually providing audiences all over the house with an excellent view of the stage floorboards while drastically reducing the effectiveness of the scenery itself.

I had prepared nine very detailed sets of plans for my ideal theatre before the depression came along and removed the need for any of them at that particular time. In all of these, however, I stressed the removal of what I like to call the "blindness of architecture," those details of structure that obtrude between the spectator and his complete absorption in the atmosphere of the theatre piece he is witnessing. I tried to conceive an auditorium that would give the fullest play to just those elements of peripheral vision that Fred Waller, quite independently, was trying to achieve on the screen.

At this point we should have one of those old movie titles, "Five years later." In 1937 my firm, Voorhees, Gmelin & Walker was invited by the Petroleum Industry to prepare plans for an exhibit at the New York World's Fair. They wanted, they said, something that had never been done before. We worked out many sketches. I, with my special interest in the theatre, took particular pride in one proposed exhibit. I wanted a huge room, spherical in shape, on the walls of which would be thrown a constant stream of moving pictures from an entire battery of projectors. Through them, in a sort of contrapuntal montage, we would show the entire panorama of petroleum built around the theme of "A World Without Friction." I could manage the architectural end all right; what I needed to know was whether it could be worked out cinematically.

And thus, enter Fred Waller. For expert technical advice I put in a call to an old friend, Charlie Bonn of the Jules Brulatour office. Bonn had only one name to suggest. It was, of course, Waller. "If it's within the realm of the possible," Charlie said, "Waller is the man who can do it for you."

We met, and I think from the very moment I outlined my problem to Waller he realized that he had found the solution to his own. Not an entire sphere, but an *arc*—that was what he


4a
4
4B
plan
4A
4B
section.

A world with out Friction:
Idea; a "talkie montage"; Room
a great exedra ((see 4 a) on
diagram); a monitor with a
battery of moving picture projectors.
two at least wide angle or on
eccentric mounts. The "talkies"
partly in Black and White and
partly in both color and monochrome,
all as nearly as possible without
background.

RALPH WALKER'S notes of a "talkie montage" for a New York World's Fair exhibit that was the genesis of the idea that later evolved, through the activities of Fred Waller and others, into Cinerama.

needed to delimit the field of vision and yet convey a sense of the all-embracing environment of his films. Furthermore, he realized, normal human vision is actually arc-shaped. The way our eyes are fixed in our head gives us a curved view of the world around us, a sweeping arc of about 160° wide and 60° high. If a picture covering that same area were projected on a *curved* screen, he argued, anyone watching it would feel as if he were right in the center of it.

Waller undertook the petroleum assignment in a fever of excitement, already looking forward to uses for this new form of motion pictures far beyond the scope of the World's Fair installation. Fired by his enthusiasm, Voorhees, Walker, Foley and Smith, our firm, put up some working capital and together we formed the Vitarama Corporation, an organization that still holds certain of the basic patents on the Cinerama machinery. Our ideas on peripheral vision coincided, and I felt that if anyone could put them into practical form, that man was Fred Waller.

Eleven months later, Fred was ready with a working model which he demonstrated to some of the oil men in charge of the petroleum exhibit. They thought Vitarama was great—but perhaps just a little too radical for their purposes. As it turned out, they finally used a fairly conventional little puppet film for their show (although I do like to think that at least the auditorium in which it was projected, a huge triangular shed open to the sun on all sides, was somewhat unconventional.) Waller himself was called in to do the dramatic exhibit in the Eastman Kodak building, a vast mosaic of rapidly changing color photographs, and he was also a consultant on the motion picture installation within the towering dome of the Fair's perisphere.

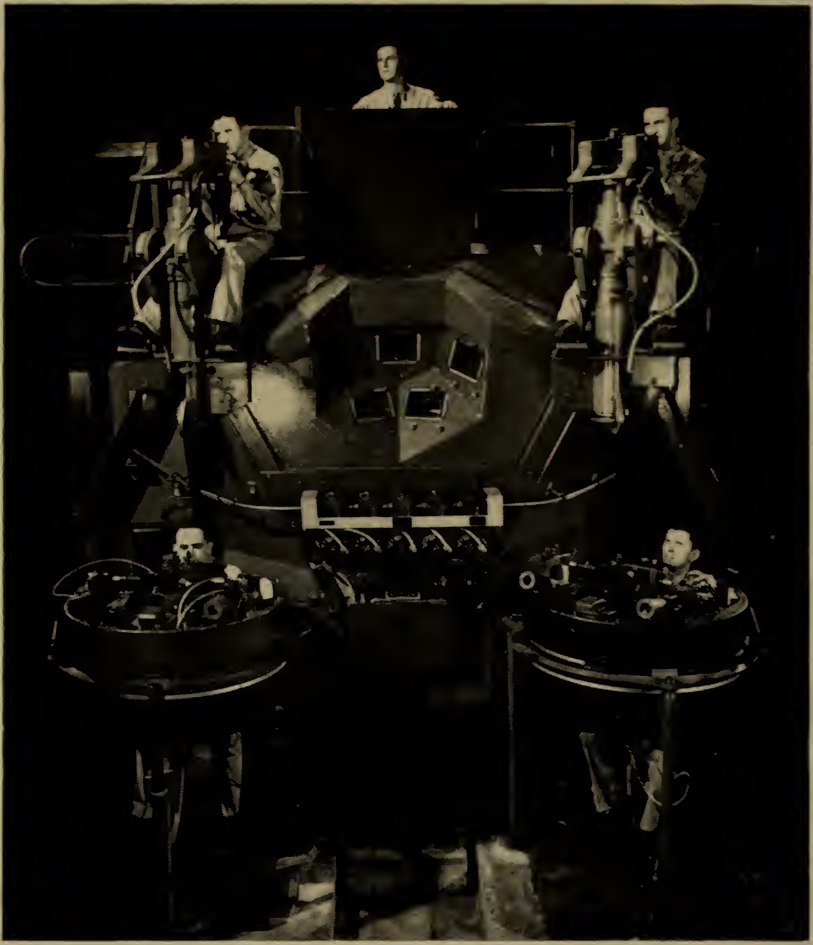
In the meantime, work went ahead on Vitarama. At this point it consisted of not only the now-familiar curving screen, but also a quarter-dome that capped it and seemed to swing the image far out over the audience's head.

In the course of his experiments, Fred had actually gone so far as to chain together eleven cameras—and, to show his pictures, eleven projectors—in an effort to produce the effect of natural vision. Obviously, with all this complexity there were many technical obstacles to be overcome. And a good deal of extra financing needed to overcome them. We were able to interest Laurance Rockefeller in the project, and soon the whole Vitarama works moved into the old Rockefeller carriage stable on West 55th Street in New York City and Perry Coke Smith, one of my partners in the architectural firm, also became absorbed in the challenge of Cinerama. We stayed on with Waller through the development of the Waller Gunnery Trainer which proved so valuable during the last war, and contributed to its engineering and construction.

Indeed, as time went by we all became so fascinated with the potentialities of Waller's new cameras that I realized one day a decision had to be made: Were we going to be architects or movie producers? I settled for architecture, although retaining a "sentimental"—and, with the current success of Cinerama—not unprofitable interest in Vitarama Corp.

I know Cinerama is still imperfect. The difficulty of matching three separate images from three separate light sources still has to be worked out. But, as against any of the other wide-screen processes that have followed in the wake of Cinerama, I feel that Waller is theoretically on the right track to completing the illusion of depth perception in motion pictures without glasses. Cinerama most nearly fulfills the necessary requirements to fool the eye.

And I have every confidence in Waller's ingenuity and inventiveness to bring his process to perfection. It is a confidence that was born sixteen years ago when we first sat down together to discuss the possibilities of creating something that had never been done before for a project that was never completed.



WALLER Flexible Gunnery Trainer developed for the Air Corps during World War II by Fred Waller. An instructor in the top position supervised the simultaneous training of four students who "fired" on attacking planes projected on a curved screen by five projectors. Aiming was electronically recorded.

Cinerama Goes to War

INVENTOR of many kinds of photographic devices and systems, Fred Waller is certain to go down in motion picture records chiefly for his Cinerama, which evolved out of the Waller Flexible Gunnery Trainer. That device was credited with saving the lives of 300,000 *Allied airmen during World War II. He has been in the photographic business for more than 40 years and continues to make important contributions to the art and science.*

by Fred Waller

ALTHOUGH CINERAMA had its Broadway premiere only about a year ago, that could hardly be called the first public demonstration of this new kind of moving picture. Years before that glittering first night audience gathered, years before that first roller coaster ride, the realistic illusion of depth and space that Cinerama offers had been tested and approved by possibly the most exacting critics in the world—the technical brass of the U.S. Army Air Force, the Navy and the Marines. But at that time it wasn't called Cinerama. It was known as the Waller Flexible Gunnery Trainer.

Not that Cinerama wasn't in the back of my mind. For years, ever since I worked in Special Effects at Paramount, I had been aware—call it a hunch, if you like—that wide-angle photography could lead to a new kind of film making, a movie that had depth as well as width and height. I found that the wider the angle, the greater the impression of depth. The only trouble was that to complete the illusion in the ordinary theatre, I would need a screen a whole block wide.

The idea remained in the back of my mind until the summer of 1938, when I was called in for consultation by the architect, Ralph Walker, on plans to show movies in a spherical room he was constructing for the New York World's Fair. That was the answer! A sphere, I saw immediately, does not arbitrarily limit the field of vision, and it actually corresponds to the way we see normally. I began to read up on everything known about how we perceive the world around us.

I began to experiment myself, now using blinkers that permitted me to see only out of the corners of my eyes, now using a mask pierced with tiny holes that permitted me to see only straight ahead. I discovered for myself just how heavily each of us relies on the elements of peripheral vision to supply an accurate picture of our environment, how much of so-called stereoscopic vision is actually a product of memory and imagination. The idea for Cinerama began to take shape.

As time went by, I discussed my ideas more fully with Ralph Walker and he came to share my conviction that we were on the verge of something big and exciting. Thanks to Ralph and his partners in Voorhees, Walker, Foley and Smith, I was provided with working capital and encouraged to begin my experiments. And as Vitarama, the first Cinerama was born.

I can honestly say that since the very start, the basic premise of my work has remained unchanged. As early as 1938 I had sketched on paper an outline for Cinerama that would stand today in any patent court as the model for the present installation on Broadway. But there have been many modifications, of course. All of my early thinking was directed toward preserving the spherical shape—not just an arc, but an actual spheric section 165° wide and 75° high. The strip construction of the screen also came in early, a necessary element to absorb the light that would otherwise bounce back and forth within the shell.

Perhaps the most radical change has been in the number of projectors. Originally I had eleven! This was due solely to the fact that, for economy's sake, I was forced to work in 16mm—for the sake of economy, and because I could rely on my friends at Eastman Kodak to procure exactly what I needed. For example, my eleven cameras had to be fitted with eleven precisely matching lenses. The good people in Rochester actually tested 931 lenses to produce the eleven that matched. Also, for simplicity of operation, I needed the monopack Kodachrome film, at that time the only color film available in 16mm. But I knew that if we ever switched to 35mm I could achieve the same mosaic effect with only five projectors.

In 1939 Walker and I were able to interest Laurance Rockefeller in the invention and he joined us in Vitarama Corporation. He was enthusiastic; we talked about putting it on at his Center Theatre. But already the clouds of war were gathering abroad. It hardly seemed like the time to introduce a new entertainment medium, especially one as costly as this. I suggested putting the whole project on ice. "Fred," Mr. Rockefeller said, "you're an unusual inventor. Most of them just can't wait until their brainchild is shown to the public. I'm glad to see that you are such a good business man as well."

By this time we had not only a working model, installed in the Rockefeller carriage house on West 55th Street in New York City, but a number of test films as well. Among the guests who saw some of these early demonstrations was an old friend of mine, Henry Martyn Baker, a graduate of the Naval Academy and an expert in ballistics. Months later—the Decoration Day weekend of 1940—Baker came to me with an idea. He had been impressed by the realism of my pictures, the way they gave the spectator the illusion of being actually "in the picture." Couldn't this realistic experience be applied to the construction of an apparatus to train men in gunnery?

We talked over the problems involved thoroughly, for hours on end. And within sixty hours I had the whole thing worked out in my head. The answer came to me while I was shaving. The clue to the problem was to do it all backwards, to start at the point where projectile struck aircraft, put the bullet back into the gun and put the plane back to where it was when the trigger was pulled and the shell leaves the gun.

Ballistics charts give the speed of every type of missile, the speed of aircraft can easily be computed, and film runs through the projector at an even rate. I had the solution to sorting hits on my gunnery trainer! At the end of the war, Army experts called this an "empirical process." "It couldn't have been wrong," they said.

All through that day I outlined my idea to Baker. He couldn't find a single flaw. For further check, we called in engineers from the Grumman airplane works, from Eastman Kodak and Kenyon Instrument. I outlined my device again and asked for criticism. For eight hours we talked the whole thing back and forth, but again none of these assembled experts could find a single flaw in my reasoning. Baker was convinced, promised to try to interest his friends in Washington in building the device.

Soon after, Major Larry J. Carr came to New York to see a demonstration of our Vitarama show and discuss further the possibilities of a trainer. At that time Larry was air advisor to Secretary of War Woodring; later he was placed in command of all gunnery training in the Air Corps. Larry arranged to let me use four bombers and three pursuit ships at Mitchell Field to make a special picture that would demonstrate better how my process could be used in combat training. I had my eleven cameras mounted in a cradle so that they handled as one, placed them in the nose of a B-18A, and began shooting film as bombers and the speedy pursuit craft closed in around us.

In August of 1940 we ran our first tests for officers of the Army Air Corps, the Navy and the Marines. At that time I could show them not only the picture, but also a crude scoring mechanism, and even the dummy gun that the trainee would use to aim at the screen. It was good enough, however. The men were clearly impressed.

When I look back on it, I frankly wonder how they ever could have been. That little projection setup on 55th Street was weirder than anything Rube Goldberg ever devised, a veritable jungle of plywood and baling wire. But it worked. Every part that required precise machining was as perfect as human ingenuity could make it. Rough plywood covered an exceedingly intricate electrical network, designed and built by Robert Dresser of the Auditone Oscillator Co., of Bridgeport, Conn.

In any case, early in 1941, while I was directing some three-minute movies for the Mills Juke Box people, I was suddenly called to the phone in the middle of a "take." It was Washington. The Navy wanted 31 trainers at once. Their experts had checked and were satisfied. They didn't even want a preliminary test model. I was to go into production immediately. I warned that after delivery there might be as high as 50 per cent error in the machining of parts. They wanted the trainers anyway. Actually, on delivery it turned out that there was only an 8 per cent change in parts required—an unusually low percentage for a first shot at any mechanism as intricate as this.

And intricate it was, the most intricate of all trainers used in the war. One friend of mine described it as looking like the end of the Triborough Bridge with four men on it, their feet dangling in air, a console like a church organ, and behind that photocells, amplifiers, levers, scanners and a whole lot more. Then, take the Perisphere from the World's Fair, cut it into four pieces, push the end of the Triborough Bridge into one of the pieces and you have a Waller Gunnery Trainer!

Actually, each of those four men was seated at a replica of a 50 cal. machine gun, built so that when it was fired it had all the kick of the original gun. Each gun was connected to a special panel, a recording device through which a film was run in perfect synchronism with the pictures on the screen. This film was patterned so that whenever the gun was aimed in precisely the right position for a hit on the target, an electrical impulse, a high "beep-beep-beep," so informed the gunner through his earphones. Four of these, mind you, each with its own recording panel and its own scoring film running through it own projector.

The console was where the instructor sat, above his trainees. Before him was a panel that indicated, among other things, how many bursts each student had fired, how many bullets, how many hits each scored. Also a microphone through which he could speak to the projection room and to each or all of his trainees, a "still" button which enabled him to hold any single frame on the screen for as long as five minutes, a pilot light that flashed whenever a hit had been scored. And a switch controlling a light mounted on each gun that permitted him to see, on the screen, where each or all of his students were aiming. (The student himself couldn't see this light; it struck the screen at the point covered by the central spot in his own aiming sight.)

And below, in the heart of this monster, was a battery of five standard Century projectors operating in synchronism as a single mechanism. Each was trained upon a separate portion of the screen, supplying the mosaic that built the entire image.

Precision framing minimized the points of overlap, aided further by the fact that the throw was relatively short. We used standard 35mm color film, running at 24 frames per second. One particular problem in the projectors raised in the Navy's specifications for the Trainer: it was desirable, for purposes of instruction and analysis of shots, to hold a picture on the screen for five minutes. For this I designed a heat-absorbing glass filter as a heat shield, an automatic dimmer for the lamp itself, and a fairly elaborate cooling system that forced a stream of air about the lamp and the film, then carried it off through an exhaust.

For our Trainer's screen, the original strips would have been impractical. Instead, we prefabricated sheets of plywood, bent to shape and marked for assembly upon a light frame. The inner surfaces of the sheets were covered with an aluminum powder in a gum solution which, by controlling the thickness of the solution, made it possible for us to control the angle of light reflected from the face of the shell. Incidentally, we had already determined upon directional sound to complete the illusion. Three loudspeakers, placed behind the screen, would have located the aircraft's position by sound. We were persuaded, instead, to supply a steady roar to the students' earphones, interrupted only by the "beep-beep-beep" when he had scored a hit.

If all of this sounds complicated, it was child's play compared to the register machine that made the guide marks on the scoring films. The machinery itself filled a room 30 feet by 40 feet and 30 feet high. This was so intricate it could only be operated by mathematicians. Each frame of film that passed through the trainer had to be pre-analyzed, determining at just what point a gun firing at the target would score a hit. This information was then recorded electronically on four control films, one for each gun position, to run synchronously with the picture. Dresser's photoelectric controls on this machine were nothing short of masterful.

In all, we turned out 75 gunnery trainers during the course of the war, most of which, of course, went to the Air Force. The cost per Trainer was $41,500; while the total cost of our entire operation—installations, making the films and the control films, servicing, training personnel to operate the Trainers—came to about $5,250,000. We made separate films for each branch of the service, arranged in series of progressing difficulty. All in all, we used over 300,000,000 feet of film in the three years we produced the Trainers.

Even in the movie business, I dare say, $5,250,000 sounds like a lot of money. Actually, compared to what the Army spent for Air Corps training with live ammunition it was minimal—perhaps the equivalent of three days' training. But our Trainer had further advantages. For the first time a trainee knew when he had scored a hit *at the instant that he made it.* In the usual towed-sleeve type of practice, a few hours after his firing a gun the cadet would discover how many bullets had hit home. But he wouldn't know which they were, nor how he was aiming at the time he made his strike. And, of course, there were no casualties in our type of training.

I remember vividly a group of four T-Sergeants just in from the Pacific. They had all had combat experience, had in fact been on one of the air fields that the Japs struck on the day after the attack on Pearl Harbor. I remember the comment of one of them as he looked over the Trainer for the first time: "That must have been some crazy s.o.b. who dreamed this up." They asked for a demonstration, then insisted on taking an entire course. They were going back to the Pacific, they said, and the training they got on our machine gave them the best education in gunnery this side of actual combat. "If I'd had just ten minutes of this," one added, "I wouldn't have missed those first six Jap planes."

From the Navy came the report that the first convoy on which the gunners had been Trainer-trained shot down nine attacking German Stukas, driving away all the others. Up to that time exactly one Stuka had been downed. The Air Force has officially estimated that more than 250,000 casualties were averted by the training made possible on our machine in that branch alone.

With Trainers all over the country, in Hawaii and England, many running 24 hours a day, seven days a week, this new kind of moving picture experience was seen by thousands and thousands of men. I began to hear more and more frequently, "When are we going to see regular pictures like this?" Indeed, I received well over a thousand such requests from G.I.s alone.

Once the war was over, it seemed like the most logical thing in the world. I was able to interest some new investors—Time, Inc., "Buzz" Reeves of Soundcraft Studios and, of course, Laurance Rockefeller was still with us. We formed the Cinerama Corporation to promote the theatrical end of Vitarama, and I went back to the shops and back to my original Cinerama conception. I can assure you, it was far less complicated than working out the Gunnery Trainer.

A cylinder replaced the sphere, the arc was enlarged, the strip screen came back, the projectors were reduced from five to three. Dresser and myself worked out an original sound system. But that, of course, is another story—a story that won't end until we have simplified Cinerama down to the point where it can play any theatre in any community. And I think I know how even that can be accomplished.

Adding the Sound to Cinerama

TRAINED as an engineer at Georgia Tech, Hazard E. Reeves has devoted his whole career to finding better ways to record and reproduce sound. In 1933 he founded Reeves Sound Studios, of which he has been president ever since. He also has been associated with other companies in the sound field, not to mention Cinerama, which he endowed with the most wonderful sound system put into theatrical use up to now. He has been a leading pioneer in magnetic recording.

by Hazard E. Reeves

THE IDEA of stereophonic sound is not new. As far back as April, 1940 the Bell Laboratories had demonstrated the startling realism possible with a multi-channeled sound-on-film system. Walt Disney's "Fantasia" later the same year introduced directional sound for the first time to the ordinary movie-goer —at least to ordinary movie-goers seeing it in the few first run houses wired to handle the new technique. It used a three-channel recording setup, and I am sure that many who remember "Fantasia" have noted some similarities with our own Cinerama sound.

In 1940, however, stereophonic sound was premature. It died aborning, and for a very significant reason. "Fantasia" linked a wide angled sound system to the ordinary, narrow screen. Technically, with its limited equipment, it worked very well, but practically, even aesthetically, it was wrong. It was wrong because it needed a wider picture to complete the illusion. As it was, sound seemed to emanate from beyond the edges of the frame, falling off the screen in a way that proved more distracting than stimulating.

In 1940 Fred Waller, the inventor of Cinerama, invited me to a demonstration of his new process in the Rockefeller carriage house on West 55th Street in New York. Like everyone else who saw it at that time, I was tremendously impressed with it, despite its crudities, despite its all-too-apparent limitations in that early phase. Unlike so many of the others, however, I wanted to do something about it, but Waller had to shelve Cinerama—Vitarama, as it was called then—because of the war. Fred had already begun work on his Gunnery Trainer. Even so, I said to him, "Fred, when you get around to putting sound on your picture, let me know."

In 1943 I started to investigate magnetic film as a means of achieving high fidelity in sound recording. The motion picture industry started off using the photographic process in sound recording which has had definite limitations. Of course, this process took the place of the Vitaphone process which used phonograph records in its sound reproduction. The limitations in quality in photographic recording can definitely be defined. The frequency response adopted by the Society of Motion Picture Engineers was a range from approximately 125 to 7,000 cycles. These standards were set up due to the limitations of the photographic printing process and also the amplifier and loud speaker limitations.

These standards as originally established have continued until this day. However, it is hoped that the advent of Cinerama and the use of magnetic recording will drastically change them. FM, long-playing records and especially TV, have helped to increase the public's interest in high quality sound reproduction. The current enthusiasm for *hi-fi* sound in the home is symptomatic of a new renaissance in sound. I sincerely feel a new era is just beginning.

Magnetic film for sound recording has proven a great step forward in raising the level of sound quality for motion pictures. From the very beginning both its greater flexibility and fidelity recommended it to the documentary people in the east. In 1948 Joseph Lerner made "C-Man" the first full-length feature using magnetic sound. The recording was done at Reeves Sound Studios in New York City. Now magnetic film for recording is being used almost entirely throughout the film industry. But this development, which should have come from within the industry itself actually was developed independently and without industry aid.

The same is true for Cinerama. Just after the war, Fred Waller called on me. He was ready to go ahead, working out the theatrical possibilities of his Vitarama, trimming down the Gunnery Trainer into a medium for the theatre. I joined with him, Laurance Rockefeller, Time, Inc., and several others to form the Cinerama Corporation. Fred moved into that now-famous tennis court in Oyster Bay to develop his camera and projection mechanisms. At the same time, my group began to build Cinerama's sound system.

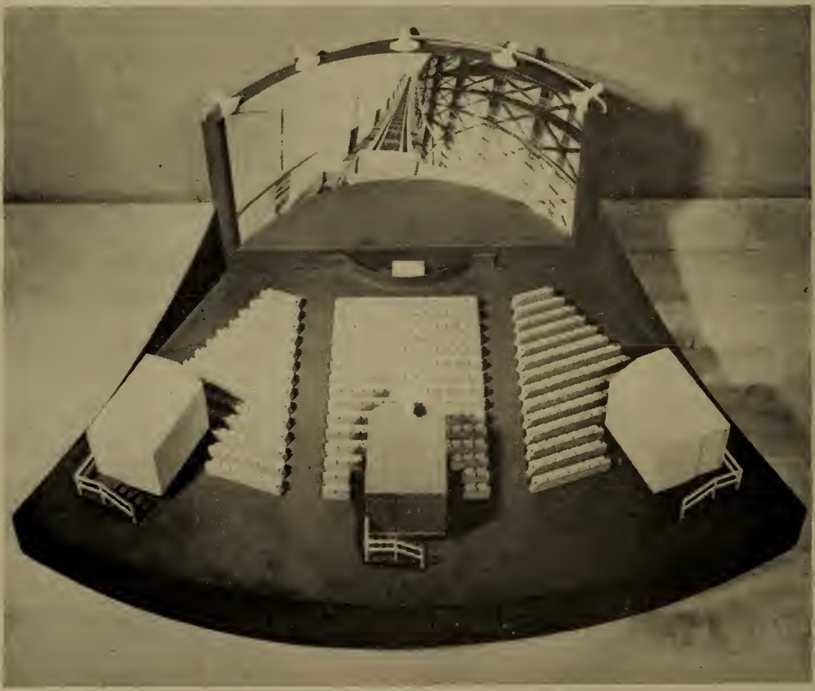
To me it was a real challenge. This would be the first multiple magnetic sound recording equipment ever devised. Since we could establish our own sound standards, we decided to go all out for high fidelity. We concluded that five loudspeakers behind the screen was the very minimum for a good stereophonic effect. (Ideally, there should be an infinite number of speakers behind the screen). In addition, we wanted speakers in the rear and to the sides of the house to create offstage effects when desired.

An additional control track was also available for special use. In producing a Cinerama film, five microphones are placed about the scene to cover all the action within the range of the camera. Other mikes may be placed off to the sides, to the rear —anywhere—to record offstage effects.

By spring of 1949 our equipment was complete and we had shot a number of short films to use as demonstrations. Then began the really heart-breaking part of the business. We invited everyone we could think of out to Oyster Bay—leaders of industry, leaders in the theatre, movie executives, writers, technicians. Everyone was impressed. But there was a terrifying inertia about their enthusiasm, too many "buts." It was fine, but there were too many technical problems. It was great, but it was too expensive. It was marvelous, but what would become of all the fine films in vaults out in Hollywood if this thing should ever take over?

Actually, less money was spent between 1947 and 1949 in the creation of Cinerama and its first test films than is generally spent on the average Grade B movie. But it *looked* big, and people were afraid. Then in July of 1950, Time, Inc. backed out, followed by Mr. Rockefeller. They generously afforded me the opportunity of acquiring the assets of Cinerama Corp. I felt it would be wrong to let this thing die without giving the public a chance to decide its merits.

The next few months were spent in an effort to interest a potential producer in making a first feature on Cinerama. The trips out to Oyster Bay were resumed. We invited producers, both film and theatrical. We even took out theatre executives.



THEATRE model of a typical Cinerama installation. Projectors in each of the three booths throw a portion of the picture onto the large, curved screen. Above the screen the five speaker horns symbolize the stereophonic sound installation. In actual practice the loudspeakers are located behind the screen and also on the side and rear walls of the theatre.

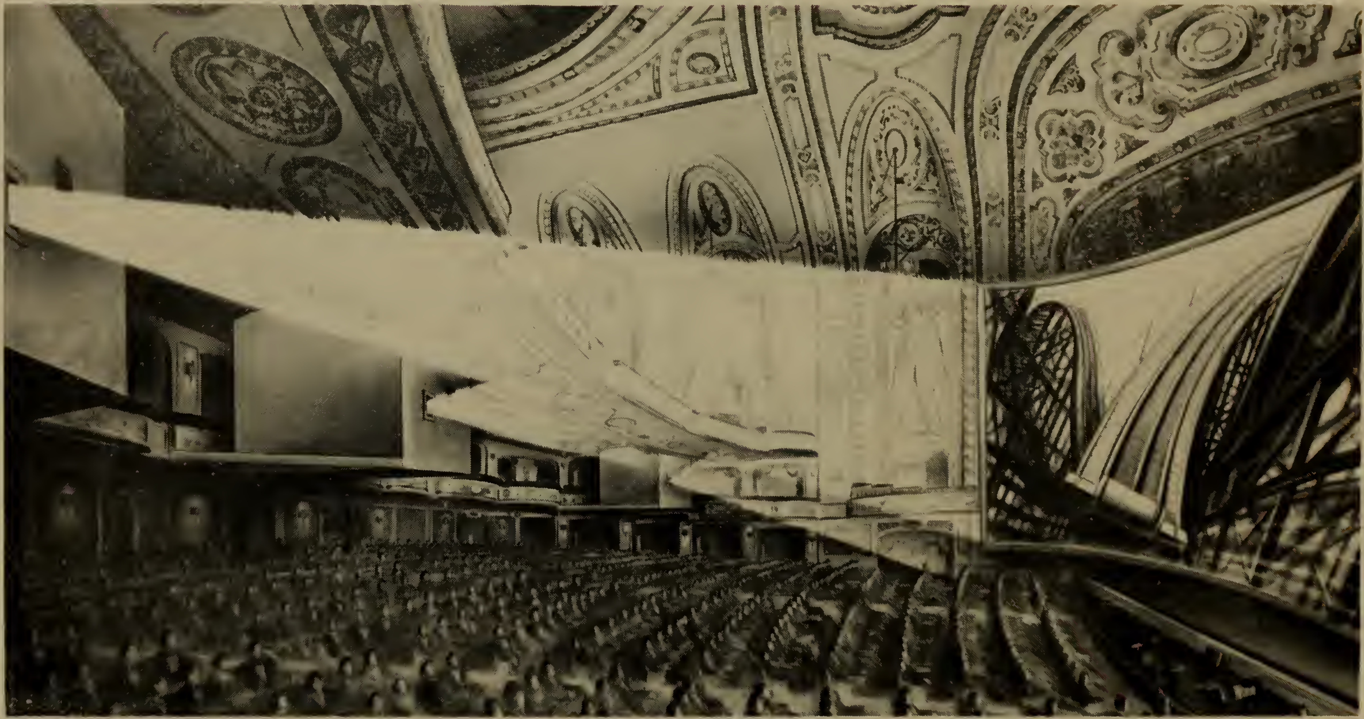
This time, however, I was resolved that the process had to sell itself. Either our future Cinerama producer was going to be vitally interested in it, or we weren't going to be interested in him. I decided to take literally that old kiss-off line, "Don't call us, we'll call you." And we did get some nibbles.

Hal Wallis, the movie producer, began negotiations. It was even announced in the trade papers that he was going to produce the first Cinerama feature. But he changed his mind. Then Lester Cowan, together with a group of theatre owners, became seriously interested.

It was just at this time that Lowell Thomas dropped in to see me. He had recently returned from Tibet and was filled with stories. Then, quite casually, he asked me what I was doing. I told him about Cinerama, and a few days later showed it to him. There was no mistaking Lowell's enthusiasm. He was all for it. He wanted to get the ball rolling immediately and, with Frank Smith and the theatrical producer Michael Todd, Lowell formed Thomas-Todd Productions. Frankly, I couldn't have been more delighted. Lowell was a showman, but not chained to the thinking, the superstitions, the inhibitions of the motion picture crowd. There would be no, "We can't do this because it has never been done before."

Our first picture, with Cinerama as the only star, opened the eyes of the public to a new kind of motion picture entertainment. I like to think that it also opened their ears to a totally new kind of sound in the theatre. Their acceptance of both has meant a great deal to me. But I know that we can do more. Fred is still working on the development of the cameras and projectors, and on a number of new patent applications. I know how much more can be done with the sound. Used to present musical comedy or opera, it can give audiences a greater sense of "presence" than even a live show. We can create a wholly new kind of theatre. The potential powers of stereophonic sound alone can achieve a new entertainment form.

Everything about Cinerama can be improved, made less expensive, made more effective. Its future as an entertainment medium, I firmly believe, lies completely in the hands of those technicians, engineers—and artists—who have been called upon to develop the potentialities that I know are within the process itself. The public has already demonstrated its willingness to support them.



OPENING roller coaster scene of "This Is Cinerama" as seen through the eye of an artist. In this installation the three projectors are located above the auditorium floor and are built out from a mezzanine.

This Cinerama Show

FAMOUS as a commentator of radio and screen, it was Lowell Thomas who furnished the drive that resulted in the opening of "This is Cinerama" on Broadway. As a world traveler and early producer of adventure-travel films he saw in the Cinerama system possibilities of bringing to the people at home the wonders of foreign lands and their interesting people. He is president of Cinerama Productions.

by Lowell Thomas

FORMER PRESIDENT Herbert Hoover, while in the White House, as well as in recent years, has so often shown by his actions and his words, that he once was an engineer—one of the foremost engineers of our time. But never did he reveal it more graphically than in a recent comment he made concerning something revolutionary that has literally turned the entertainment world upside down.

Said the ex-President: "I believe the Cinerama is the fifth great revolution in pictures: (1) Silent movies; (2) Talkies; (3) Color; (4) T.V.; (5) Cinerama."

No superlative adjectives there. In fact no adjectives at all. Yet what more potent comment than that could be made?

From coast to coast Cinerama has been the talk of the year. So far it has been presented in only three cities; New York, Detroit and Hollywood—with perhaps Chicago and one or two others by the time this appears in print. In spite of this, Cinerama is a subject of conversation in almost every city, town and village in North America. Mail requests for tickets have poured in not only from all over America but from foreign lands as well. One party radioed from far-off Singapore, asking for tickets on a certain date. The Russian delegation to the U.N., unable to get reservations when they wanted them, told their woes to the chief delegate from another country. He, wanting to show that he had more influence than the "Russkies," phoned Grover Whalen, modern "Father Knickerbocker," asking if he could pull off the miracle, just so this Ambassador could show to the gentlemen from Moscow that he had more "pull" than they.

The Cinerama premiere, of course, was in New York. Seven months later it arrived in Hollywood. My colleagues and I were a little worried. We figured that maybe Hollywood, still the film capital of the world, might resent such a long postponement, and be annoyed because New York had the premiere of this revolutionary cinema innovation. But, happily it didn't work out that way. Dick Button, Olympic star, foremost skater of all time, wrote me as follows: "The most frequent comment around us at the Hollywood premiere was: 'I expected another one of these 3-D things, but nothing as fantastic as this. It really will change the movie industry.' "

I had planned to be at the Hollywood opening but at the last moment was obliged to fly to New York. So my wife and I gave our tickets to a newly-wed couple—the bride, a widow who owns the farm next to us in New York State's Lower Berkshires. She reported that one of my old friends, Charles Skouras, sat behind them, and kept saying over and over: "This is the best of them all! Why bother about the others?"

The *Los Angeles Times* gave the long-delayed Hollywood presentation nearly a full page in the news section, under the following heading:

CINERAMA GIVES FILMS NEW THRILLS—
SHOW OF SHOWS OUTDOES ALL IN
DAZZLE, EXCITEMENT, MAGNITUDE.

Jimmy Starr, in his review in the *Los Angeles Evening Express,* summed it up thus:— "Movieland's revolutionary new medium—Cinerama—brought old-time Hollywood glamour back to the boulevard last night . . . it was Glitterville's most exciting night since the late Sid Grauman opened the Chinese Theatre."

Just what is Cinerama? How did it happen to happen? How many years have been spent developing it? Why did the Rockefeller and Time and Life people step out? And how did it finally emerge from the laboratory? These are some of the questions that are put to me almost daily as I move around the country.

No doubt you have noticed how some of the major events of your life come about through pure chance, an item that you see in a paper, a fragment of an overheard conversation, turning down one street instead of another, an accidental meeting with a friend, and so on. Well, that's the way it was with this.

It all began one afternoon about four years ago. I had been recording a picture at Reeves Soundcraft Studios on East 44th Street in New York. Now, I had known "Buzz" Reeves some twenty-odd years before, in the days when we little dreamed that he would become a top tycoon in his field. I had just gotten under way in radio, stepping into the spot where Floyd Gibbons had made a name for himself. This was right before I began a seventeen-year association with Twentieth Century-Fox, and at the time I was working on miscellaneous shorts for Paramount and other studios. "Buzz" happened to be the engineer who handled some of my recording. After that I saw nothing of him. But I did hear how he had soared to the heights as head of various technical firms.

Wondering about my old friend, who had become a legendary figure, I asked about his office and found it was right there in the building where I had just finished recording. So I dropped in and we chatted about the old days, and about the bewildering world of electronics. Among other enterprises, he mentioned he had recently bought an interest in something new and revolutionary. He told me how the heads of the Time and Life organization and one of the Rockefellers had become discouraged and sold their interest to him. He told me it had to do with something invented by Fred Waller. This increased my curiosity, because when "Buzz" and I had worked together long years before, Waller was the engineering genius and trouble shooter for Paramount. I had also worked with him.

And so it was that "Buzz" lured me to Oyster Bay. There from both Reeves and Waller I heard the story of Cinerama, how its origin went back some fourteen or fifteen years to the New York World's Fair, how the Government took it over during World War II and backed Waller in the development of a special gunnery trainer, using a circular screen that went all the way around a big room with one continuous motion picture projected by eleven machines. Then they told me how, after the war, further experiments were made possible by Rockefeller and Time and Life money. But neither the inventor nor his backers thought they had it ready for the public. It was at a moment when enthusiasm was at a low ebb that "Buzz" Reeves had arrived on the scene, bought out the other backers, and added stereophonic sound.

Then, in their Oyster Bay indoor tennis court which they used as a laboratory, they showed me some of their test shots. When I saw these I was literally overwhelmed.

I don't know, but perhaps my special background and past experience played an important part in getting it out of the laboratory. During World War I, assisted by a number of great cameramen—Harry A. Chase in particular—I had made what up to that time had been the most successful non-fiction film production ever presented. It was called "With Lawrence In Arabia—Allenby In Palestine." Actually it was a combination of two pictures, dramatic records of two World War I campaigns which were so closely related that I had condensed them into one show. This "Allenby-Lawrence" production had broken all records in London, and then for years I had toured around the world with it. Following that I had made a similar film production called "Romantic India," which was full of the glamour and adventure of the most picturesque country on earth.

So when I saw Fred Waller's Cinerama and heard "Buzz" Reeves' stereophonic sound, I thought to myself what a fantastic thing it would have been if I could have used that medium for telling the story of the exploits of Lawrence of Arabia and of Allenby's cavalry army sweeping through Palestine to Jerusalem and Armageddon! For Cinerama brings you the world of reality in a way beyond our wildest dreams.

In the forty years that I have been associated with the entertainment world I have never encountered tributes comparable to those that have been pouring in since that historic New York opening night. Enthusiastic comments — all unsolicited — have come from far and wide, from people in all walks of life.

How did we happen to build our first show in the way we did, the production called, "This Is Cinerama?" Because of what it does to real life my first thought was to call in an old friend who has often been referred to as "the father of the documentary,"—Robert L. Flaherty. Bob Flaherty, of course, is world-famous for his "Nanook," "Moana," "Man of Aran," "Elephant Boy," and others. I invited Bob out to Oyster Bay to look at the tests. To say he was excited would be an understatement. For a month or so, Flaherty tested the camera and studied the new medium. And then, alas, just as he was to set forth round-the-world, Bob Flaherty died. For the moment there was no one to take his place.

So, in the hope that I at least might set our organization in motion I rushed over to Europe and began looking for subjects suitable for a series of demonstration episodes. Harry Squires and his crew followed, with Michael Todd, Broadway producer, assisted by his son, filling in for Flaherty.

As their material began pouring in there was the problem of cutting and editing. From television we lured Bob Bendick to help on this. Also, we brought in one of the top figures of the motion picture world—Merian C. Cooper. Like Flaherty (and myself) "Coop" had begun making documentaries back in the silent days when, in association with Ernest Schoedsack, he had made such classics as "Grass" and "Chang," followed by several hundred successes from "King Kong" on down to "Fort Apache" and the recent Academy Award winner, "The Quiet Man."

"Coop's" capacity for hard work is prodigious. For months during the production of the film he would fly back and forth between the east and west coasts, often several times a week, to keep up his rigorous schedules in both New York and Hollywood. Day after day he would work right around the clock, exhausting his crews. But our production was beginning to take shape. With Bendick he cut and edited the European material, then together they went down to Florida to shoot the Cypress Gardens sequence.

Our "America The Beautiful" was conceived by several of us. Years before, Cooper, a World War I aviator, had hedgehopped his own plane through the jagged canyon country of our national parks. Wanting a spectacular finale he came up with the idea of a plane flying across the entire United States from east to west. For this he called in our top stunt pilot and three-times winner of the Bendix Trophy, Paul Mantz. He worked out, with Mantz, an itinerary for the jaunt, and virtually directed the film by long-distance telephone calls to Mantz, to cameraman Harry Squires and to Fred Rickey, the director-on-the-spot.

Of course this hodegpodge of film needed the final touches that make all the difference between a mere demonstration and real showmanship. Cooper supplied them. He brought in artist Mario Larrinaga, with whom he had worked on "King Kong" and other films, to prepare the transitions that introduce each episode in "This Is Cinerama." Also, he selected veteran composer-conductor Louis Forbes—of "Gone With The Wind" fame—to handle our complicated music problem. Scoring a film involves intricate timing, cues, following the action on the screen, and adjustments in the music right during recording sessions.

For an ordinary picture, this is difficult enough. But the Cinerama screen is almost six times the size of the average theatre screen. In addition, to take full advantage of "Buzz" Reeves' high fidelity, multi-directional sound, a whole battery of microphones had been set up, each channeling into a separate sound recorder. Forbes had to keep all of this in mind while composing, orchestrating and conducting his music!

Some measure of his success is to be found in the reactions of the audiences at the Cinerama presentations. They never fail to mention the unprecedented realism of the orchestral sound. Even more impressive is an incident that took place at the conclusion of the first recording session. Forbes asked Dick Pietschmann to run a playback of the performance, for his musicians, and the men—all drawn from the NBC Symphony, the Philharmonic and the Metropolitan Opera Orchestra—listened with rapt attention, then burst into applause. "Never before have I been able to hear myself exactly the way everyone else hears me," was the way one violinist summed up the reaction.

And then I had a special personal thrill. It was decided that we ought to have an introduction to "This Is Cinerama," tracing the development of motion pictures and leading into our new dimension, plus an introduction to the second half of the film to be shot on the Cinerama camera. A reproduction of my library was set up in my rural radio-TV studio on my farm near Pawling, N. Y. And thus I became the first actor to appear in Cinerama—with my barn-studio the first real Cinerama studio.

Meanwhile the opening date was drawing near. We had contracted for the Broadway Theatre and announced our premiere for September 30, 1952. As is customary in the business, we invited critics from the national magazines out to Oyster Bay to look at our picture in advance of the opening. But, with less than two weeks to go, we could still show them only parts of the production—and not all of that with the music track on it. "Coop" was literally still working on the picture up to an hour or so before the Broadway opened its doors.

And what a night that was! Another custom of the industry is to invite celebrities in town—the movie and stage stars, the executives and local politicos—to attend your premiere, to fill your house with glamour. Veteran MGM producer Louis B. Mayer, who became chairman of the board of Cinerama Productions a few weeks after the opening, vetoed the idea. "Why bother?" he said. "They'll all phone *us* tomorrow!"

The phones are still ringing, but even so we had a premiere that made Broadway history. The audience could have been an entire chapter out of "Who's Who In America." It included an ex-President, Governors of several states, leaders in industry and society, stars, composers, playwrights and authors, and so on. A night that was a fitting climax to the years of effort that went into the development of Cinerama, a gratifying reward to Waller, Reeves and many of us, for the time and patience and skill that had gone into the creation of the first Cinerama production. It also was a night to remember for Frank Smith, Dudley Roberts and their associates who, along with me, had organized and financed the company now known as Cinerama Productions.

At last we have removed pictures from the age-old limitation of space—the picture frame. From the earliest days all scenes, in pictorial form, have come to us in a concentrated space: square, oblong, or what-not. You were always conscious that it was surrounded by something else: a book, a wall, the setting of a room, the darkness of a theatre. Always it was something that would not fill your vision.

But in this newest development you are confronted by a picture so vast, so all-enveloping, that you see nothing else. Your eyes no longer are aware of any limitation. There is no frame. You are right in the middle of it, and that is the main point about Fred Waller's historic invention, together with "Buzz" Reeves' flood of stereophonic sound. Fred Waller calls it "peripheral vision." That is, you not only see what is straight ahead, but you also see out of corners of your eyes—just as you do in real life. In life much of the vividness is produced by the side glimpses —the things passing by. That's the most dynamic part of vision. The principal of "peripheral vision" produces an extraordinary illusion—makes it seem more vivid even than reality, because you witness a daytime scene when the theatre is actually dark. So there is no diffusion of daylight in the atmosphere, and that makes the color all the more spectacular. The scene seems to engulf you.

I sometimes wonder what would have happened if I hadn't stopped in to see "Buzz" Reeves that afternoon several years ago. We would probably have had Cinerama someday. Reeves would have seen to that. But, it might not have come for a few more years. At any rate I would have missed one of the greatest adventures of my life.

Finding Customers for a Product

Notes on the Introduction of Cinerama

IN this day when most publicists like to be called "public relations experts" Lynn Farnol continues to call himself simply a publicist. Whatever the name, he has been known for many years as one of the most skillful of the many who have worked in the entertainment fields. For many years he was associated with Samuel Goldwyn Productions. Since 1950 he has had his own organization. His promotion of Cinerama is an example of what a publicist can accomplish in attracting public attention.

by Lynn Farnol

THE INTRODUCTION of a new product (and that includes entertainment) involves some questions: Is the public ready for it? Does it fulfill a need? Since the scrapping of old goods or processes may be involved, are the new elements important enough to compensate for the loss?

The sponsors of Cinerama believed in Cinerama. They had faith that it presented a new sensation in entertainment. They believed that it was a new way of telling stories, without the old frame of the traditional motion picture. Much money and much time were staked in that conviction.

A policy was established, as clear cut and as well defined as any ever known in or out of the motion picture industry. Without making any secrets out of anything, the technical details of the operation of the new process were not to be divulged.

Interest was to be deflected from the mechanical details. Equally urgent was the policy that interest was to be deflected away from the specifics of the entertainment that were to be offered. Lastly, Cinerama was to state, bluntly and directly, that it was not a three-dimensional process.

Thus, by a process of elimination, most of the standard appeals were taken away from the advertising and from the publicity operation.

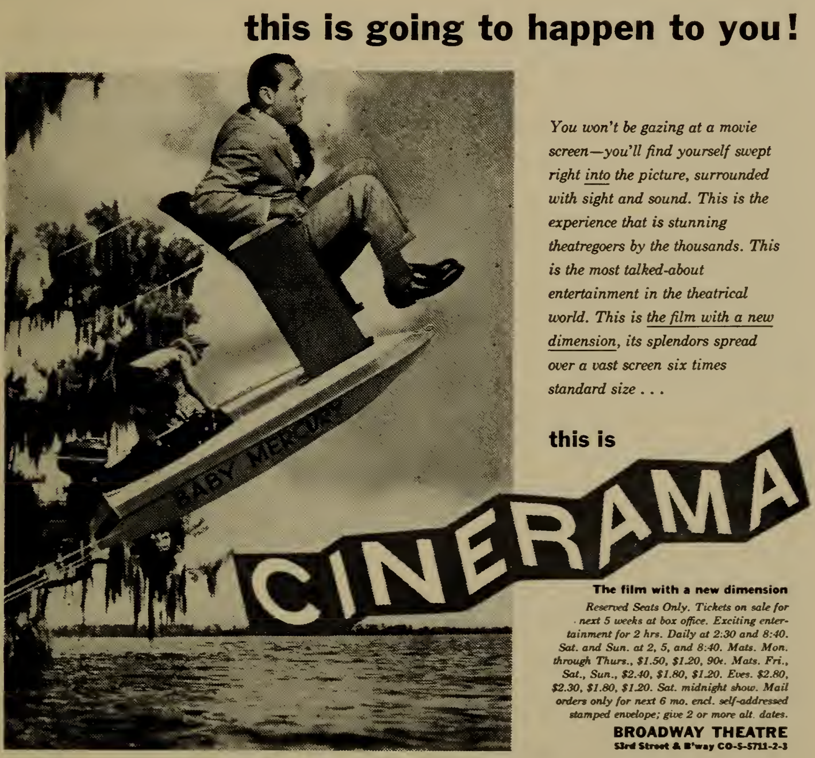
The appeal adopted by the advertising agency, McCann-Erickson, and its able account executive, Peter Schaeffer, and the company's publicity representatives was a simple one: what Cinerama does to you! It meant, during the pre-opening days, taking one editor after another to Oyster Bay to see the laboratory tests. The trip was a long one. Three hours might be spent waiting to see a five-minute segment of the film. One or two partial laboratory previews were held. The belief spread that, mechanically, Cinerama worked and, emotionally, it produced an extraordinary effect. Publications, with their two dimensions, began to improvise and plan ways of presenting Cinerama with its illusion of a third dimension. A facetious editor suggested that it could easily be solved by publishing a curved magazine.

By the time opening night came—without the benefit of any formal preview, and without anyone having seen the whole of the film—a healthy excitement and anticipation had been built up. There was a sense that new demands were going to be made on the audience. An audience was conditioned to become a part of the picture.

The basic premise of the opening night was to depart from the usual and the conventional pattern of motion picture openings. The audience was a distinguished one, comprised of many leaders from the business world, friends of the sponsors, and many leaders of the publication and radio world, friends of Lowell Thomas. But what made the event unique was that the opening night press guests included outstanding music writers, travel editors, science authorities—in fact, leaders in every field touched by Cinerama as a medium. It was an opening planned not for New York, nor for New Yorkers, but for national penetration.

It worked, in that the *New York Times* did carry the story of the introduction of the new process on the front page, and all of the wire services carried it not only once, but two or three times. Many national radio and TV commentators of the calibre of Arthur Godfrey and Edward Murrow raved about it for weeks after. Within three or four days after the opening, every city and every town in America had read or heard about the film revolution. Not only that, but once the first story appeared, it seemed to create an appetite and a demand for more news and more information.

Thousands of clippings began to pour in from every corner of the country, and from the distant capitals of the world. A carefully kept file of the 183 potential markets for Cinerama was prepared. For each city in which Cinerama may play, a complete



this is going to happen to you!

You won't be gazing at a movie screen—you'll find yourself swept right into the picture, surrounded with sight and sound. This is the experience that is stunning theatregoers by the thousands. This is the most talked-about entertainment in the theatrical world. This is the film with a new dimension, its splendors spread over a vast screen six times standard size . . .

this is

CINERAMA

The film with a new dimension

Reserved Seats Only. Tickets on sale for next 5 weeks at box office. Exciting entertainment for 2 hrs. Daily at 2:30 and 8:40. Sat. and Sun. at 2, 5, and 8:40. Mats. Mon. through Thurs., $1.50, $1.20, 90¢. Mats. Fri., Sat., Sun., $2.40, $1.80, $1.20. Eves. $2.80, $2.30, $1.80, $1.20. Sat. midnight show. Mail orders only for next 6 mo. encl. self-addressed stamped envelope; give 2 or more alt. dates.

BROADWAY THEATRE
53rd Street & B'way CO-5-5711-2-3

A NEW dimension thrill was stressed in all Cinerama advertising. Emphasis was placed on what was going to happen to the spectator. Here Peter Schaeffer, McCann-Erickson account executive, served as his own advertising model.

collection of everything that has been in print in that area is available. The measure of public interest and information is immediately and accurately available.

Once the opening was accomplished and the story of Cinerama carried across the country and around the world, the next problem became one of building up an operational plan and an acceptance of mail order sale for tickets. It is a practice used in a limited way in the legitimate theatre, and not at all in motion pictures. McCann-Erickson used coupon advertising and radio spots to invite orders by mail. Publicity announcements and feature stories stressing the ease and convenience of buying tickets by mail became increasingly effective as tricks of the trade were learned.

Once the New York operational procedure became established, it became fairly easy to adapt publicity and advertising techniques to Detroit, Los Angeles, Chicago and other key cities. The effort and the pattern continued to be the same. Make an event out of the opening. Stress the emotional excitement that is in the film. Avoid a program of parts for the entertainment, and leave the technical details alone. Because mail orders are the very basis of a successful operation, stress the fact that Cinerama will not be shown in neighborhood houses, and carry the announcement of opening and the ticket sale to the widest possible area, so that an extended circle, including as many as 20 surrounding cities, might be included.

As an operation of merchandising entertainment, it *was* sound and it *is* sound. Cinerama was launched with a label that was scrupulously honest and fair to the public. It was presented as a process that might satisfy a great need and hunger of the public for something new. The public provided its own answer. They got what they wanted. In precipitating the revolution in entertainment that it has, much of what the industry regards as its most valued properties may be made worthless, but something was accomplished, too—audiences came back to theatres.

And now what? How long the technical mechanical problems will continue is anyone's guess. It is a reasonable supposition that in due time, they will be evaluated in terms of cost of installation, in terms of operating costs, in terms of what they give an audience as a process. Then the question will be not which of the processes do we prefer, nor how good are films that convey a third dimension or the illusion of a third dimension, but instead, another and more important question: What is the industry doing with its new dimension? What stories are they telling better, now that they have this new dimension? In other words, what have we to say in Cinerama or any other process?

PROFESSOR Henri Chretien, French optical scientist, developer of the anamorphic lenses used in CinemaScope.

CINEMASCOPE

Importance of CinemaScope

THE enthusiasm and energy which Spyros P. Skouras, president of Twentieth Century-Fox since 1942, has put behind the development of CinemaScope is characteristic of the man. Having started in the motion picture business as an exhibitor he has always realized the importance of showmanship and has never forgotten that the industry's function is to provide the best possible entertainment.

by Spyros P. Skouras

IN PRESENTING CinemaScope as a new medium for better screen entertainment, Twentieth Century-Fox feels the same sense of responsibility to the whole industry which led it to work unceasingly to find a means of combating the competition of television.

Our efforts in this direction began following World War II. Anticipating the growth of television, we embarked on a research program with the idea of perfecting large screen theatre television in order that the theatres could successfully meet the competition which had proven to be very formidable as home television has developed and grown.

For a period of three years, the research engineers of this company and those of the Radio Corporation of America endeavored to perfect such a system and expended large sums in its development.

In the course of this research, we presented in the Fox Theatre in Philadelphia on June 25, 1948, the first inter-city transmission of large screen theatre television when the Louis-Walcott fight was shown to an astonished and pleased audience.

However, when these research activities did not meet our expectations, we turned to a system developed by the Swiss Institute of Technology and known as Eidophor. With the cooperation of the Columbia Broadcasting System, which agreed to license its color sequential system to us, this company perfected the prototype of the present Eidophor large screen color television system for theatres. This system was presented last year through a series of demonstrations which brought acclaim not only from the motion picture industry and exhibitors, but from many other representative groups as well, and now General Electric is developing for us a commercial model which will be as simple to operate as a home television set.

With the introduction of Cinerama, Twentieth Century-Fox went a step further in seeking a means that would give Eidophor a scope approximating the wide range of Cinerama and, in the course of this endeavor, we acquired and developed Professor Henri Chretien's anamorphic lens. This lens, when adapted and tested, proved to have such immediate possibilities that it was combined with Stereophonic Sound and our own Miracle-Mirror screen to become what is now CinemaScope in the eyes of the amusement industry and the public throughout the world.

No effort has been spared to put this system upon the soundest possible basis so that it will be a synchronized process of as near technical perfection as it is possible to make it, and a medium for presenting entertainment that will be profitable and satisfying to every element of our industry, particularly the exhibitors.

For this reason, our executives and our research experts labored, first of all, on the task of assuring the industry of an adequate number of anamorphic lenses both for photography and projection. To supplement the supply of these lenses which the inventor, Professor Chretien, agreed to provide, they worked night and day to insure a further flow of lenses by aiding the American firm of Bausch & Lomb to acquire the delicate and precise knowledge enabling them also to manufacture them.

For this reason, similarly gruelling endeavors went into the further development of the Miracle-Mirror screen and long hours were put in with equipment firms best qualified to produce this screen to get the highest standards of quality.

Likewise, unstinting efforts were continued throughout this period to bring stereophonic sound to the highest possible point of development so that this process would take its place as a vital component of the CinemaScope package.

Even so, this was still not enough to meet our exacting requirements and our engineers again did not spare themselves in solving the problems of combining four magnetic sound tracks on a single 35mm film—an achievement of almost equal importance, practicability and economy to CinemaScope itself. This achievement was instantaneously recognized for its importance to exhibitors in the saving of time and expense involved in handling, processing and examining films.

Our purpose has been to establish CinemaScope on a firm and durable basis. In comparison with those systems which have only a novelty appeal or which are based upon methods which inconvenience audiences, we offer a system which we believe will have a lasting importance to the industry.

CinemaScope stands on its own as a complete system consisting of screen, lenses and multiple sound outlets in which every imperfection possible has been eliminated. It stands on its own because it is no make-shift process, in contrast to some large-screen projects which merely involve the "blowing up" of ordinary motion pictures to a size intended to be impressive.

CinemaScope is a system that begins with the conception of the screen story to be told, and is followed through the new techniques of CinemaScope production to the final point where its scientific advantages result in a superior product on the screen.

We feel our responsibility very greatly because the men who own and operate the theatres of this country have seen CinemaScope, have appreciated it in comparison to other systems and are applying for the equipment which will make it possible to bring CinemaScope to the people. More than 4000 such applications had been received as of June 21. While these did not all represent actual commitments, they were indicative of the trend.

Because of the acclaim received by CinemaScope in the United States, made even more eloquent by the willingness of hard-headed showmen to invest in it, its fame has spread to motion picture circles in every part of the world and similar applications for installations have reached Twentieth Century-Fox from every Canadian province, Hawaii, Puerto Rico, Alaska, Japan, South Africa, Mexico, France, Australia, New Zealand, the British Isles, Italy, Sweden, Greece, Argentina, Columbia, Chile, Brazil and Cuba.

Following the demonstrations in the United States, which began with those in Hollywood and New York and continued with Chicago, Philadelphia, Detroit and other key cities in the United States, this company presented the system in European centers beginning with London and Paris, and all other capitals. As in the United States, we negotiated with equipment and supply companies of Europe in order that at least every first run principal city in free Europe will have CinemaScope installations by the end of 1953.

In the United States, our expectation is that manufacturers can produce equipment for 1,500 to 2,000 theatres by that time and 750 to 1,000 per month thereafter as demands require.

This is our answer to the importance we attach to this new development in motion picture entertainment with the release of "The Robe" in CinemaScope not later than October 1, 1953, with its premiere at the Roxy Theatre in New York City and similar openings of the picture in other world centers. We believe that the world audience of motion picture patrons will recognize that a new day in the movie theatre has dawned.

From that time on, there will be a steady flow from this company of CinemaScope productions with "How to Marry a Millionaire," "Twelve-Mile Reef" and "Prince Valiant" following "The Robe" in that order and to be released before December 31, with a long succession of other CinemaScope pictures in production or in preparation to be released at the rate of one every four weeks.

That is another answer to the estimate of CinemaScope's importance—the fact that our entire production of important pictures is in this medium.

CinemaScope is important to the exhibitors because it is a simple and happy combination of photography, sound and color which imparts vivid life to the screen and reality to the action beheld by the onlooker, and therefore will attract the patrons to the box office.

Since the Miracle-Mirror screen, which is adaptable to any theatre, large or small, is especially suitable for CinemaScope as well as any other type of regular or dimensional film, this is another advantage for the theatre man.

The CinemaScope package, as a whole, is economically attractive because it involves a few simple changes in the theatres, including the installation of the screen and additional microphones, and the attachment of an anamorphic lens to the present projector.

It will add nothing to the cost of operation because the ordinary projector, equipped with this new lens, will need no additional generators, large magazines or interlocking devices. No special training will be needed for the projectionist because the projector will be operated in the normal manner.

As exhibitors, other members of the industry, the press, business and financial leaders, critics and many others have noted during the demonstrations held in Hollywood and New York, the simplicity of CinemaScope, as well as the powerful illusion of reality it provides, constitutes its greatest appeal.

One of the further attractions of CinemaScope in the theatre is that it is equally enjoyable to onlookers sitting anywhere in any part of any theatre.

Above all, the comments that have been made voluntarily regarding CinemaScope recognize that CinemaScope will mean for millions everywhere a new kind of experience in entertainment, with motion pictures being provided for them in a new form and with a magnitude changing all previous concepts of the screen.

Story-telling on the screen is given a new dimension by CinemaScope and our production experts have achieved marvelous results in quickly developing new techniques for the making of CinemaScope pictures and adding richly to their impact. Producers in all parts of the world are seeking the right to use the camera lenses which are part of the CinemaScope equipment.

Exhibitors who have applauded CinemaScope feel that it is a foregone conclusion that the public will feel as they do because something new under the sun met the eye and ear when the demonstrations were held. This created a new spirit of confidence and anticipation throughout our industry. The exultant note that rose above all others was that a revolutionary change in motion picture entertainment had become a reality.

CinemaScope in
a theatre. On the
screen a scene
from "The Robe."

CinemaScope in Production

AS vice-president in charge of 20th Century-Fox production it was Darryl F. Zanuck's responsibility to decide the extent to which CinemaScope was to be used by the studio. After studying tests filmed in the process he decided that the entire output should be converted to CinemaScope. Mr. Zanuck became head of the 20th Century-Fox studio in 1935. Prior to that he was chief production executive of Warner Bros., and organizer, with Joseph M. Schenck, of 20th Century Productions.

by Darryl F. Zanuck

IT HAS BEEN gratifying to us of 20th Century-Fox to have our original enthusiasm for CinemaScope not only endorsed but exalted by leading producers, distributors, exhibitors and qualified members of the press from all over the world.

At this time we have yet to receive, of course, the most important of all acceptances—that of the public itself. But we are not worried about the public verdict. After all, we not only have the assurances of the outstanding figures of the industry, whose judgment must be regarded as expert, but we have tested CinemaScope with cross sections of the average audience. The results have surpassed our highest hopes.

As I see it, the excitement of this amazing new medium may properly be divided into two phases—exhibition and production.

The exhibitor may now show his patrons things the eye has never before witnessed in a theatre. Spectacle has always been one of the greatest, if not the greatest, magnets for audiences. Now we have a potential unequalled in all the long centuries of theatrical history.

For some years showmen have realized that a cardinal entertainment value was the ability of the audience to identify itself with the happenings on the screen. The bookkeeper was happier if he became Gregory Peck and his girl friend enjoyed herself most when in her mind she became Susan Hayward—and made love to Gregory Peck. Through CinemaScope this illusion becomes much easier. Members of the audience seem to be surrounded by the action on the curved and greatly enlarged screen. The figures have more substance; the voices have more timbre and direction and clarity. The increased scope of the projection cannot fail to draw the audience into the action on the screen.

It may not be amiss to say a word here on the subject of novelty. We believe that stereoscopic processes depending solely on novelty will not be able to sustain their appeal to the public. Something new but possessing more solid values is required. This CinemaScope supplies with its simulation of the three-dimensional illusion as well as its other great qualities. At the outset CinemaScope will enjoy the advantages of novelty, but its success does not rest upon them.

We producers have the advantage of all the thrilling elements mentioned above plus the wonderful challenge of using to its utmost the newest and best method of telling a story the theatre has known. I have both heard and read the commentary that despite CinemaScope the play is still the thing, that stars are still important. Of course they are. CinemaScope is not a substitute for a story nor for good actors. But it does give us more octaves in which to tell our story and gives our actors greater range for their talents. It provides the intimacy of a play, the movement and variety of films, plus an unprecedented potential for the effective presentation of both. I think all of us in the production end are going to have to show more imagination and ingenuity to use this new instrument properly. A musician can be a wonderful artist with a mouth organ, but true genius must be fulfilled on the violin.

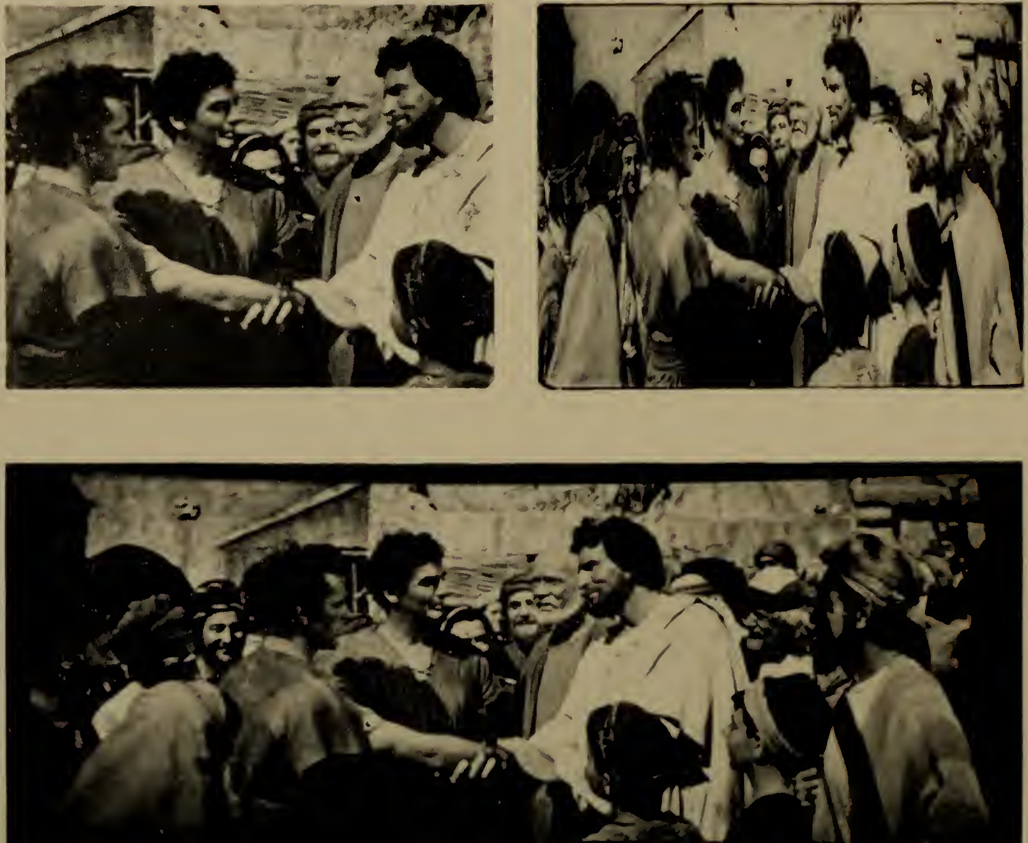
None of us is blind to our responsibility here. We shall handle CinemaScope with the respect it deserves. Spyros Skouras, president of 20th Century-Fox, made this crystal clear following the first showing of CinemaScope before a group of the industry's top producers in Hollywood in January, 1953. He said: "CinemaScope is going to be a name that means quality. We shall use it only for our very best product and will see to it that other producing companies employing this medium meet the very highest standards of entertainment."

I submit that these words are being backed by deeds. We made "The Robe," the biggest and most expensive production in our company's history. We quickly followed with "How to Marry a Millionaire," starring not one, but three of the top feminine names in this business—Betty Grable, Marilyn Monroe and Lauren Bacall. We followed that with "Twelve-Mile Reef," a romantic melodrama set in the Florida Keys which through CinemaScope will bring to the screen for the first time all the beauty and terror of the sea.

After that came "Prince Valiant," a drama based on the King Arthur legends which millions all over the world have been following through Harold Foster's syndicated newspaper feature. It is worth noting that Mr. Foster's drawings have been the admiration of artists and the public alike. So much so, that CinemaScope literally had to be invented before they could be properly put on the screen. All CinemaScope productions will be equally important.

It must be plain then that Mr. Skouras' words are being fully implemented. This fact gives me the deepest personal thrill. From the beginning I have felt that CinemaScope was too significant to be debased for a quick dollar. It was given to us for the pleasure of millions and we must live up to our responsibilities to audiences everywhere.

Our actors now can move without fear of moving out of focus. Relatively they've been moving in handcuffs and leg irons and so has everything else on the screen, from jet planes to alley cats. CinemaScope is an Emancipation Proclamation on the sound stages. Like all freedoms it must be exercised soberly and intelligently. We think we are doing it.



CINEMASCOPE vs. standard 35mm pictures. Top left a scene filmed in standard 35mm; top right, the compressed CinemaScope image. Below, the CinemaScope picture as expanded to normal on the screen.

Sound for CinemaScope

THE story of CinemaScope's stereophonic sound told by Lorin D. Grignon is basically the story of all stereophonic sound systems. Mr. Grignon began his motion picture career as a sound man at Paramount in 1929. He joined 20th Century-Fox in 1940 as a sound engineer and since then has concentrated on sound development engineering. In addition to CinemaScope he has worked on a number of important sound projects.

by Lorin D. Grignon

THE SOUND METHOD used for CinemaScope is known technically as stereophonic. What is this method and how does it differ from other sound methods such as now used in motion pictures, radio, phonographs and tape machines?

Conventional methods do not make it possible for a listener to receive a truly natural impression of recorded sounds. Such recordings are made by what might be called a *one-ear* system. This is true even when more than one microphone is used to pick up the original sounds because the output of the microphones is usually combined into one sound track or record and reproduced through one speaker. The effect is that the audience hears the original performance much as it would have been heard by an observer deaf in one ear.

A person with normal hearing perceives through each of his ears sounds that are not precisely identical. The reasons for this are several. Unless the sound source is directly in front or behind, there is an appreciable time lag between the hearing of the same sound in one ear and in the other. The human head itself acts as a barrier affecting high frequency sounds in the ear furthest away from the source of the sound. In addition, the normal sense of hearing is selective because—through psychological activity arising from the aural stimuli received from each of the ears—the brain is able to focus attention on certain sounds and wholly or partially exclude others.

While hearing through two ears gives to all sounds an added quality over that obtained by one-ear hearing, the chief function of our two ears is to enable us to receive an idea of the physical location of the sound. A person with only one normal eye has no difficulty in locating the *direction* of an object; he misses some of the factors in the perception of depth. On the other hand a person with hearing in only one ear has considerable difficulty in determining *direction* of sounds and focusing attention on those he wishes to hear.

There are two methods of sound reproduction which take advantage of our two-ear hearing. Recording by the Bin-aural method is done by the use of two microphones located in a dummy head with one of the microphones oriented as one human ear and the other as the other. Provided the output of each microphone is separately recorded and the two recordings separately reproduced in earphones worn by the listener, the effect is to transport the *listener* to the position of the microphones at the time the dialogue was spoken, music played or other sounds made. For these reasons recording by the Bin-aural method is neither very practicable nor desirable for theatre use.

However, the purpose of stereophonic sound recording is to reproduce the *performance* at the location of the audience. The difference between Bin-aural and Stereophonic is subtle in this regard but important. In the case of a motion picture, stereophonic recording reproduces behind the screen all the sounds of the performance in their proper spatial relationships so that each of the spectators by *two-ear* hearing can locate the various speakers and sounds even if the eyes are shut. Since the environs and source of the sounds are reproduced quite faithfully in a new listening location (behind the picture screen, offstage or elsewhere in the theatre) each member of the audience hears with both ears as though the actual source of the sounds were before or around him.

Theoretically stereophonic sound could be recorded by any number of microphones placed across the area of the performance with each microphone independently connected to a separate recording device. In practice, it has been found that three suitably located microphones are sufficient. When a recording is made, there must be three separate sound tracks whose physical relation one to the other must always be maintained. Consequently, there must also be three reproducers to take the signal from the sound tracks, three sets of amplifying equipment and three loud speakers. From the instant of pickup to the ultimate loud speaker the sounds "heard" by the three microphones must be kept independent, for, should the recordings be combined so as to make a single recording, the system becames a one-eared device and markedly inferior to the single track conventional method.

Now, with a system of recording as briefly described, the result will be to have sounds reproduced as though they came from the direction in which the source is seen. An actor pictured on the right hand side of the screen speaks from that visual position and if he walks across the scene speaking dialogue all the time the reproduced sound travels with him. Original offstage sounds are reproduced offstage. Two or more actors in different places in the scene seem to speak their lines from their visual positions. The instruments of an orchestra are heard from the direction of their true positions.

We may now list the advantages of stereophonic sound as follows:

1. The visible position, or placement, of sound sources are matched by the direction from which the reproduced sound is heard. In other words, the spatial relations as regards sound are now maintained rather than all the reproduced sounds coming from *one* place behind the screen.
2. The changes in sound as actors turn, move about, go more or less distant from the camera are very much the same as we hear in life and so we can say the distance or moving effects are life-like.

3. The acoustic result, or effects of the environs of the original sound are well reproduced and situations which are difficult for conventional recording are considerably eased.
4. As a result of (2) and (3), the apparent quality, or faithfulness, of the recording is greatly improved.

The reader will better appreciate the above ideas by conducting a simple experiment. While in a room with several people talking, cover one ear tightly and notice how the directivity of hearing is lost, how the quality or feeling of the room has changed, how much more difficult it is to understand the speech and to separate what you wish to hear from that which you do not. When the ear is again uncovered, the difference is analogous to going from conventional recording to stereophonic methods.

The initial stereophonic demonstration was given in Philadelphia in 1933 by Bell Telephone Laboratories when they reproduced what was occurring on one stage at another location with a similar stage. In this situation, the problem was to reproduce the sounds essentially life-like in spacing and distance. Motion picture practice is not limited to looking at a full scene at all times as happens with a stage performance. The camera is frequently taken closer to the performers or the set but, in a specific theatre, the picture size remains fixed, so on occasions actors, or objects in the picture, are shown normal, less than normal or greater than normal in size. In other words, there is picture magnification or reduction and this complicates the stereophonic sound problem because a similar effect must be evident in the recording.

We shall see that it is necessary for all three of the microphones used for stereophonic to move independently, as required, to fit the scene which the camera is photographing. The theoretically correct placement of three ideal microphones would locate one side microphone about one-sixth of the scene width in from the edge of the scene, the other side microphone similarly on the opposite side and the third microphone in the center. All three microphones would usually be in a line. A simple diagram will be helpful in absorbing the above ideas.

Consider Fig. 1. When the camera is photographing Scene A, almost all of the set is included in the camera angle. If we now imagine the camera as a film projector and put a screen at the same position as the set and of the same physical size, the reproduction will be life size. This is shown in the diagram by including the screen and using the same angle for projection as for the camera. Behind the screen are depicted three loud speakers and dotted lines are drawn from each loud speaker to the camera or projector. An actor, or other sound source, anywhere along or near one of these lines must be recorded so that the sound comes principally from the loud speaker intersecting that line because the camera view so places that object in the frame and the projector does likewise.

Now, if the set is moved closer to the camera (rather than moving the camera closer to the set) we can consider Scene B. The camera now sees only a part of the original set but when this camera picture is projected to the same screen as before we note, by comparing the width between the camera sidelines, that the projected picture is greater than life size.

Sound sources within Scene B located anywhere on one of the dotted lines must again be recorded so that the sound comes principally from the loud speaker intersecting that line. Now, in Scene B, actors may be physically close together but on the

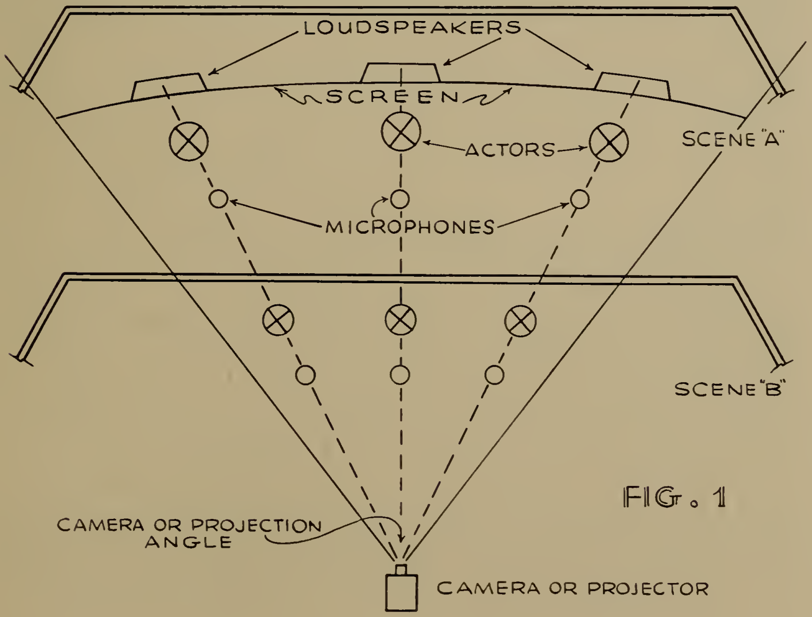


FIG. 1

screen they appear to be greatly separated, therefore, the sound must be recorded to achieve a magnification, or spreading, which is analogous to picture magnification. Note that in Scene B the microphones must be closer together but in the same proportional relationship in the camera angle as before.

Fig. 2 illustrates a specific scene where only one microphone needed to be moved and the camera did not pan or move. The only reason for the movement of the left microphone was to improve the pickup from the entering actor. In general, so as to accommodate the great variety of circumstances of motion picture production, it is mandatory that directional microphones be used and further, the ability to adjust the directivity facilitates the job of keeping proper sound location and perspective. For those who desire more detailed technical information on microphone placement reference may be made to the Journal of the Society of Motion Picture Engineers, Vol. 52, No. 3, March 1949, wherein was published a paper on the subject by the writer.

There is a method of recording pseudo-stereophonic which has had some use. This method provides only the first of the advantages listed above and is as follows. The dialogue is recorded in the conventional one-ear method. After the picture is edited and during the re-recording process the single channel

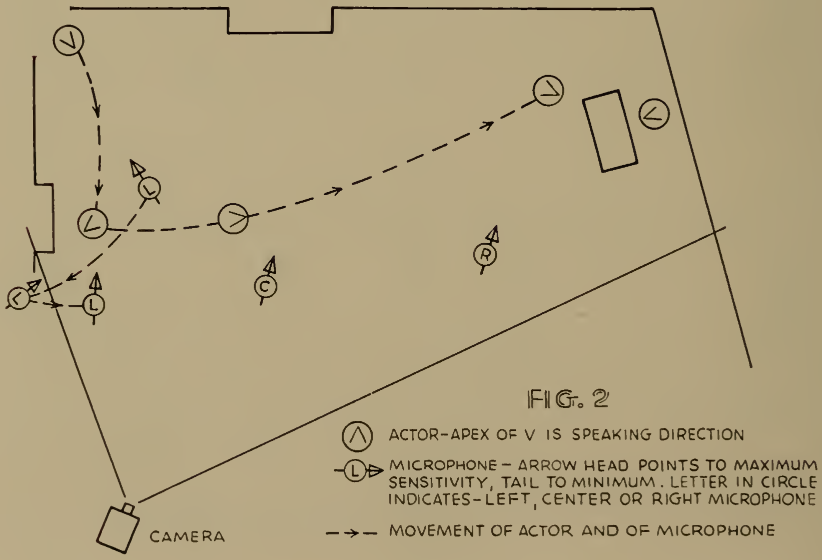

L
C
R
CAMERA
ACTOR-APEX OF V IS SPEAKING DIRECTION
MICROPHONE – ARROW HEAD POINTS TO MAXIMUM SENSITIVITY, TAIL TO MINIMUM. LETTER IN CIRCLE INDICATES-LEFT, CENTER OR RIGHT MICROPHONE
MOVEMENT OF ACTOR AND OF MICROPHONE

FIG. 2

(mon-aural) recording is put through a special kind of volume control called a "panning potentiometer." With this device a single input can be transferred to any one of three outputs and hence the input sound can be moved smoothly from side to side through the middle of the scene, or divided between the outputs without the total apparent output volume changing.

The recording mixer operates this control so as to move the sound around to fit the picture. For the release print the three recording tracks and reproducing systems are still required. When this method is used, no overlapping dialogue which needs different placements can be permitted; if the dialogue from different actors follows rapidly it is impossible for one man to operate fast enough to place the sound from the separated actors and hence the dialogue must be cut into individual tracks so more than one man can simultaneously operate the placement control; no other sounds which have individual movement can be originally, simultaneously recorded with the dialogue.

It has probably become evident to the reader that the sound man must at all times know how the actors are being located in the camera frame. When the director and cameraman line up a scene, the sound man must determine the actor positions from the camera finder, arrange the microphones and specify the microphone movements always to fit the various actor locations. If during the actual photographing an actor assumes some location quite different than rehearsed or the camera movements are not the same, the sound man must be informed so that he may decide the suitability for the shot.

So that the maximum of sound realism may be obtained we can now summarize the basic requirements for stereophonic sound.

1. There must always be correct placement of the apparent sound reproduction corresponding to picture placement.
2. When actors or effects move there must be smooth transit of sound from one to any other location, without large changes in quality or volume.
3. There must be some pickup in all microphones at all times.
4. The sound man must know the actor locations in the camera frame at all times.

As with all technical matters, more understanding is needed, and complications result when any process is expanded to do more things. This holds for stereophonic as compared to the relatively simple conventional recordings. It is easily possible for the director to plan a scene so involved that it would be virtually impossible for the sound man to do a proper job. If sound placement is grossly in error, it is easily noticed or if the sound placements jump around without actor movement the result is annoying to an audience.

These defects might be compared to the situation where the audience has become accustomed to a life-like reproduction and then are suddenly subjected to something foreign. It is also evident that the cameraman must be much more cooperative with the sound man than has been previously necessary. The cameraman must now light so as to avoid shadows from three microphones. There are some circumstances where the possible locations for the microphones are exceedingly few and the sound man can give way very little to the cameraman. On the other hand, there are situations where the sound man can ease the problem of lighting.

The necessity of voice dubbing or post-recording of dialogue in motion pictures is recognized. This arises, of course, when it is impossible to record sound due to such circumstances as interfering noise or physical limitations. Dubbing of stereophonic is possible but since there are additional factors of placement, acoustics and sound perspective to be matched simultaneously with proper dialogue and lip synchronization, the process is more difficult and expensive. Insofar as it is at all practical to do so, the producer, director, cameraman and sound man should exercise every effort to minimize dialogue dubbing.

When dubbing is necessary, the actor observes himself in the picture, which is usually prepared as a continuous loop of film so the section is repetitive and matches his dialogue and movements to that of the picture. With the acoustics selected to match the scene and the three microphones properly placed, a reasonable match can be made. In some cases, it is possible to move the microphones rather than have the actor move, in which instance the actor is relieved of this problem and can concentrate on the dialogue. The acoustics of the dubbing room are important because stereophonic, as has been noted, reproduces the characteristic of the original set rather well and any change of dialogue quality or environmental reproduction within a scene is quite obvious. This demands that the acoustics of the dubbing stage must be controllable over a considerable range from "dead" to "live."

The re-recording process for stereophonic is basically the same as heretofore as regards dialogue and music. In some instances, small corrections in placement can be achieved by adjusting the relative volumes from the three tracks. This cannot be carried too far because if any one track is reduced in volume considerably, the system becomes a two track method with somewhat inferior results.

It is impossible to abandon the tremendous stock of recordings in the sound effects libraries and to replace them with stereophonically recorded material. Further a library of stereophonic effects would, necessarily, be considerably greater because of the variety of movements which must be met. By the use of the panning potentiometer already described, it is possible to take a single track effect and to introduce it, by re-recording, into a three-track stereophonic system in such a way that the sound effect can be continuously located or moved at will. For example, this means might be used to cause automobiles to move across the screen as desired. The effect of offstage sounds can also be achieved.

The reader will recognize that extra operations are required and with some very complicated scenes, using a large number of different effects, the demands on the personnel cannot be met. The very complicated effects can be handled by pre-re-recording or combining of effects to reduce the number of operations during the final re-record. With magnetic recording methods this procedure is facilitated because there is no delay for the processing of the record. There are some effects which can be tremendously life-like by recording them stereophonically and these are instances when it pays to produce the effect, if possible, specifically for the picture rather than try to build the desired result from stock material.

A particular example would be a professional automobile race involving many cars passing the camera at a variety of speeds and in many different combinations. Such a scene is ordinarily difficult enough to make sound realistic, but with the added requirement of movement it becomes well nigh impossible to do so correctly in a reasonable time.

Stereophonic music recording for backgrounds or titles is straightforward in that it is merely necessary to pick up the rendition with good quality and instrumental balance, using the sound placement feature of the method to provide spread and instrument separation. The improvement in quality of recording resulting from stereophonic methods is most marked in music work. A deleterious effect to avoid is the changing of sound placement of specific instruments once their location has been established. This bad effect can be caused by variable sound reflections within the music recording studio.

When musical performances are included in the picture a more difficult problem arises. It has long been established that it is far better to record musical numbers before photographing the scene, and to perform the scene, while photographing in synchronism with a playback of the previously recorded music.

In this way the music recording is of uniformly good quality since it is not subject to the varieties of stage conditions, the shooting is usually less expensive because fewer people are involved, the operation is less complicated, tempo is more uniform and music continuity smoother because it is not done in sections but continuously, as a regular performance might be.

This procedure is called pre-scoring. Now, with stereophonic, we demand that the performers' locations in the picture be matched by the sound locations but if pre-scoring is to be used then the sound men must know beforehand how the scene will be photographed so that the recording will fit the final picture. This, of course, means that someone, the director or producer, must plan the shots *before* recording and follow this plan when photographing the scene. Such a procedure limits the director to the scenes he has planned without much latitude for change or improvement later.

An alternate procedure provides a temporary pre-score which can be single channel rather than stereophonic with the desired tempo and length for the contemplated scene. This temporary recording is used for playback in the usual way, carried through the editing operations and finally replaced with a properly done stereophonic recording which matches the final picture with all of the scene cuts. There are also some pseudo-stereophonic methods other than the use of the panning potentiometer which provide a limited control of placement but do not provide the other features of true stereophonic.

Music with vocal recordings presents the same problem as with music alone but to a somewhat greater degree. It is customary and most satisfactory to record the vocal and orchestra on separate channels which are then later combined in re-recording to give the most suitable balance to fit the edited picture. It we consider that the orchestra is always seen in the same location or not seen at all a straightforward stereophonic recording suffices for the music. The recordings ot the vocal must be planned before photographing or recorded at the time of shooting.

This latter procedure prescribes a music playback which can be heard by the performer but not picked up by the microphones being used for recording the vocal. Equipment for this purpose exists but is not always satisfactory. A much less satisfactory method but a great deal simpler is to record the vocal on a conventional single channel system, record the music stereophonically, make the scene with music playback and lip synchronization and during re-recording place the vocal rendition to fit the picture by means of the special control mentioned previously. This, of course, means that the vocal quality suffers somewhat.

When the orchestra location has been established by some previous scene in the picture it becomes necessary to record or somehow provide that the music seems to originate from the established location even though this location may be offstage in some scenes. It is of interest to note that when stereophonic vocal and music are combined the orchestra volume relative to the vocal may be used considerably higher. This feature is apparently due to the similarity of stereophonic to two-ear listening.

Editing of stereophonic is very little different than is now common practice. The editor must be careful that any offstage dialogue or effects are cut into the picture so as to match any previously established origin of the sound. Intercut scenes which show an actor or sound source far to the side of a picture and then cut the same source to the far opposite side are quite jarring to an audience, but there may be circumstances where such jarring is dramatically effective and the use of the technique is justified.

Present practice permits an editor to take sound tracks of lines from any suitable take of a scene to intercut for offstage lines but with stereophonic, on-stage dialogue will not sound offstage. Therefore, the dialogue should be specifically recorded offstage or done later as a voice dubbing. Sound placement may be used for dramatic effect in many ways and in this manner the editor now has another means at his command for creating an illusion or attracting attention as seems desirable. It should be observed that long diagonal splices cannot be used because the cut will intersect the three tracks of the record, film or magnetic, at different points. The cut must be straight across.

At the present writing there are some general observations which can be stated as follows:

1. Stereophonic or, at least, sound placement, is practically a necessity for wide screen pictures.
2. Producers, directors and management must be more aware of the sound problem. In return for cooperation and with ingenuity and showmanship on their part the presentation of their product, the ultimate picture, can be greatly enhanced by stereophonic sound.
3. Stereophonic sound can provide a great new freedom in dramatic and realistic effect, because placement and improved quality are available.
4. In a broad sense, scenes which are difficult in conventional sound methods are easier and conversely, some simple scenes for conventional work are more difficult in stereophonic pickup.
5. The sound man must always know the location of the sound source in the camera frame.
6. The post-recording of dialogue is more difficult than formerly.
7. The re-recording process is complicated by the necessity to match sound to picture and to fit in effects movements. Quality corrections must be done on all sound tracks simultaneously so that some equipment is needed in triplicate.
8. Direction and editing will require some change to most advantageously use the features of stereophonic.

It is quite obvious that the sound man's work is made more complicated by the use of stereophonic but he is now in a position to be of much greater value to the creative art of story telling by motion pictures.

Directing in CinemaScope

THE assignment to direct the first feature in CinemaScope, "The Robe", went to Henry Koster, veteran director of many outstanding motion pictures. Mr. Koster began his career as a commercial artist and newspaper writer. Later he was screen writer and director in Berlin, Vienna and Budapest. He came to Hollywood in 1936. Since then he has directed important features for the principal studios.

by Henry Koster

WITH CINEMASCOPE, a director is at last free of the camera and has an unparalleled chance to demonstrate his ability to move actors logically and dramatically. Now, more than ever before in motion pictures, he has room in which to work. He no longer has to worry about cramping his action because of the hampering restrictions imposed on him by the camera. Now he doesn't have to worry about "dolly shots" and "pan shots" and "boom shots" and all other camera movements; he is free to concentrate on the chief task of drawing superb performances from his players.

CinemaScope places a director somewhere between the stage and the screen technique. On stage, he has great freedom of lateral movement, but he must sacrifice the emotional impact of the closeup. In 2-D movies, he was able to deliver the closeups, but had to forego all attempts at composition of his actors in great crowd scenes. CinemaScope is the happy blend of the two: you have the luxury of the wide screen and the blessing of being almost constantly in closeup—and closeups not of a single person, but of two, three or half a dozen simultaneously.

Let me use a scene from 20th Century-Fox's first CinemaScope Technicolor production, "The Robe," as an example. Dean Jagger, playing a Palestinian patriarch, has called a meeting of his village, to introduce them to Michael Rennie, playing Peter. Prominent in the group are Richard Burton and Victor Mature. Now, in the old-style movie, I first would have had to shoot a long-shot, to show the villagers coming to the marketplace and to establish the scene. Then I would have gone in close, making individual shots of all four of my principals and perhaps a few locating shots of places around the square. Then I would have made reaction shots from members of the village. Then I would have made some two-shots: Jagger and Rennie, Burton and Mature, Burton and Jagger.

But when it came time to shoot this scene with CinemaScope, I placed my camera in a central spot and forgot about it. Because the lens catches such a wide scope of action, you will see Burton and Mature enter from the left, while Jagger and Rennie come from right center and the villagers flow in from all directions. Jagger starts to make his speech—and we see him and the three other men, all in closeup! It is much more effective

THIS scene shows how the CinemaScope lens encompasses actions that are widely separated.

to watch their reactions to the speech when you can also see the speaker.

Remember, I have not had to move my camera! This is where the director's ability to stage a scene is important. Instead of moving the camera into the actor to get a closeup, I stage their movements so that they walk into the closeup. In that respect it is like the stage—you must arrange the action so that the audience's attention will be focused on the center of attraction.

One thing I found in directing "The Robe" that I did not anticipate beforehand was that the "extras" must act, too. No longer are they shapeless, faceless blurs in the background. With CinemaScope, everyone is in focus at all times. If your extras fail to react, or display the incorrect reaction, it is as glaring an error as if the same mistake had been made by a principal. That is why I found it necessary to interview every one of the 5,000 extras used in the picture. I needed more than "types," I needed actors.

In brief, CinemaScope makes the movie director less dependent upon the cameraman and the film editor. It gives him freedom, but freedom always carries responsibilities with it. The director must now combine the staging ability of a theatrical director, the composition technique of a first-rate painter (because he is working on a large canvas), and the eye for pictorial effectiveness which he has always needed.

To direct the first picture in CinemaScope is the greatest thrill, and the greatest challenge, of my career. Think of it—to be a pioneer at my age!

New Medium—New Methods

THE second CinemaScope film, "How to Marry a Millionaire" represents a sharp difference in theme from the first. The director, Jean Negulesco, had an opportunity to show how the system could be used effectively for intimate scenes. After early training in Rumania, Mr. Negulesco came to Hollywood and worked successively as an assistant director, screen writer and director. In 1941 he directed short subjects for Warners and later made many features at that studio. Since 1948 he has been at 20th Century-Fox.

by Jean Negulesco

THE CinemaScope process, which has inspired a great deal of merited enthusiasm from all branches of the motion picture industry, also has inspired many jokes. Before I had a chance to understand fully what this new technique meant I got off a crack or two myself.

"Writing for the new wide-screen should be easy," I told my script writer. "All you have to do is put your paper in the typewriter sideways.'"

Well, he didn't laugh, either. My store of chuckles soon ran dry when I began to realize the challenge we faced in shooting the 20th Century-Fox production, "How to Marry a Millionaire," in the new process. This story was nothing like "The Robe," ideally suited to the new medium, a movie replete with Biblical and Roman pageantry, jumping from Rome to Palestine to Capri.

Nor was my story anything like "Twelve Mile Reef," the third movie slated for the new process. That one was to be photographed against the breathtaking backgrounds of the Florida keys, with plenty of exciting underwater footage.

But "How to Marry a Millionaire" tells about three hard-working girls who reach a momentous decision: given the choice, they would rather marry a rich man than a poor man. It had its own type of breath-taking scenery, in Betty Grable, Lauren Bacall and Marilyn Monroe. It was to be filmed mainly in apartments, restaurants, night clubs and other swank interior hunting grounds. It was essentially a comedy. The question that bothered me, and many others, was this: Could CinemaScope tell such an intimate tale?

We feel now the answer is Yes. But it required some adjustments on the part of both writer and director. The new process brings the audience into the action, makes them feel they are in the same room with the performers. When you have a theatre-full of people eavesdropping on your dialogue at living-room range, your dialogue has to be good and your story has to be about something. In the old days, way back in 1952, a clever director and an experienced film editor could frequently punch up a scene and give it extra stimulation by a series of quick cuts and alternating use of closeup and medium shot.

Now the burden rests upon the director. Padding, false notes, dull exposition become apparent quickly. Let us return to the

New York's skyline in a CinemaScope test reel.

living room of the previous paragraph for a moment. When the room is crowded for a large party, a bore might escape your notice. But CinemaScope puts you and the bore in close contact —so, for all our sakes and salaries, we'd better have few bores.

CinemaScope offers a director some positive advantages. It broadens his horizons and makes possible the dramatizing of situations which would be confined and imprisoned on the printed page or in a mouthful of dialogue. No director has the power to portray with montage or long shots the magnitude and spirit of New York City as we have done in this picture with a single shot of the city's skyline at dusk. This single picture was so moving that audiences at the CinemaScope demonstrations applauded it, as though it were a symphony orchestra.

The wide canvas of CinemaScope also frees the director from his former mechanical shackles. You can now visualize your scenes in their entirety, as a playwright does, and not be cramped by thinking of them in terms of "cuts," "dissolves," "closeups" and "inserts." A director no longer will have to worry about cutting down a scene of enormous scope to fit the narrow limits of the old-style camera. The realism of the big screen, its ability to project a life-like illusion, will inspire greater realism. Finally, CinemaScope's third-dimensional sound lends an importance to the dialogue equal to that of the stage.

Filming "The Robe"

ALTHOUGH a graduate of Columbia University in mechanical engineering Leon Shamroy soon turned his career to cinematography. He has received Academy Awards for color cinematography for "Black Swan," in 1943, "Wilson," 1945, and "Leave Her to Heaven," 1946. As cameraman for "The Robe" he faced the task of directing lighting and filming of the enormous sets to take full advantage of the CinemaScope lens.

by Leon Shamroy, A.S.C.

NOTHING WILL JUMP out at you from the screen when you see "The Robe." Instead, you'll have a keen sense of participation in the action.

In watching the test footage which preceded the regular shooting of "The Robe" I was immediately aware of the disappearance of the proscenium. This is one of the fundamental technical differences between CinemaScope and the conventional cinematography. With the lack of consciousness of a framework imprisoning the action you feel as if you were actually witnessing an event, rather than watching a picture of it.

To me this spells a new combination of objective and subjective entertainment. Now, for the first time, movies will be neither wholly objective nor subjective. By adding the subjective aspects without upsetting the audience, CinemaScope offers the ticket buyer a unique opportunity to help fashion a new experience.

In "The Robe" CinemaScope has achieved what the earliest Greek dramatists sought. It makes the audience part of the play. The huge curved screen gives the viewer a feeling of being surrounded by the action and, therefore, participating in it. This illusion, created without glasses, is complemented by stereophonic—or third dimensional—sound which makes voices seem to come from the lips of the speaker.

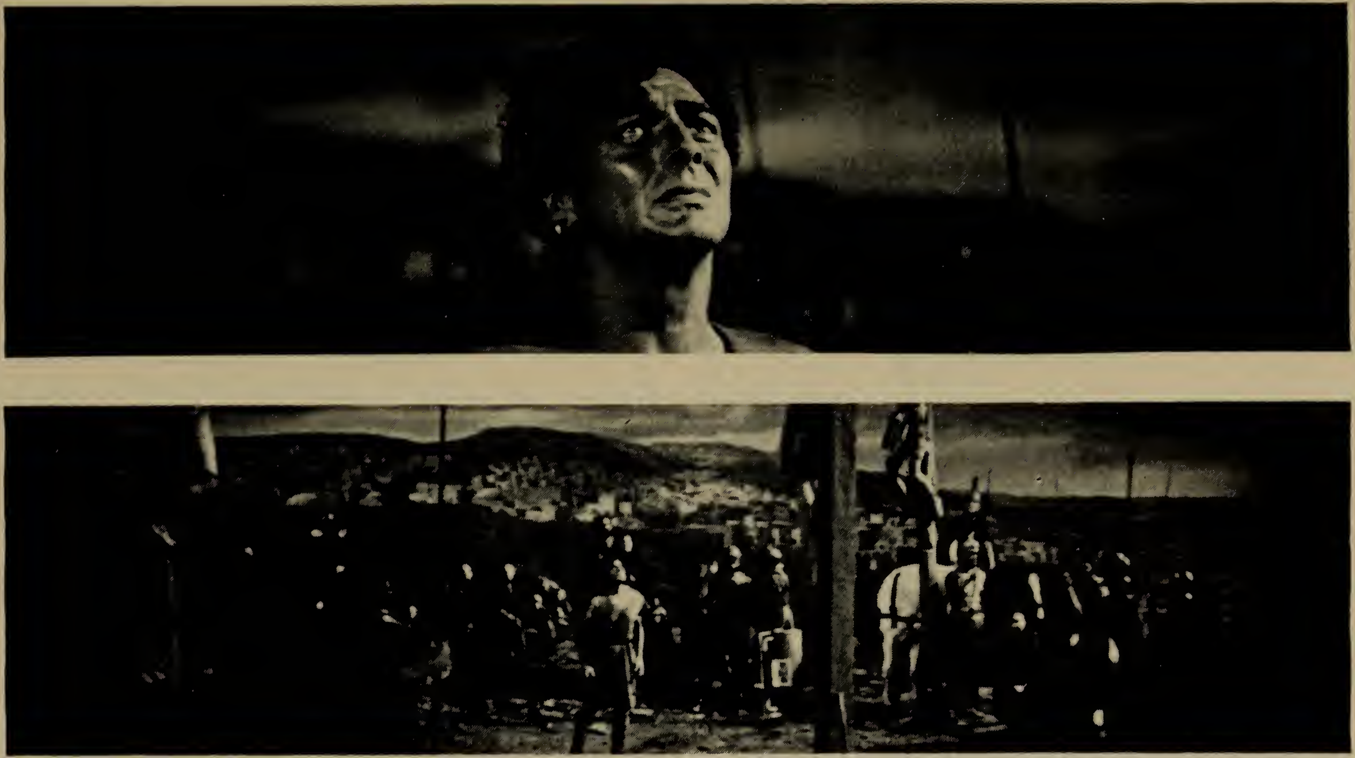
Because of CinemaScope's immense screen, it also achieves what pioneering D. W. Griffith strove for—the delineation of cause and effect simultaneously. No longer must the cinematographer cut from one bit of action, showing cause, to another bit of action showing effect. In one big scene the CinemaScope camera shows both.

This advantage of the revolutionary medium is best illustrated by one scene from "The Robe." A Roman archer in the left foreground pulls his bow and sends an arrow into the heart of actor Dean Jagger standing with Richard Burton and Victor Mature, 75 yards away. Yet the audience sees all of this in virtual closeup—the arrow leaving, the arrow traveling, the arrow hitting its target, the pain of surprise on the actor's face, the actor falling. On any other film medium this cavalcade of action would have required a half-dozen different camera setups and a half-dozen confusing film cuts. We did this in one smoothly flowing, life-like scene, thanks to the broad angle lens of CinemaScope.

It is my opinion that CinemaScope should always use color film, although black and white is feasible. For "The Robe" Eastman Kodak developed a single-strip film that suited our needs although we are promised a faster film for the future. Color prints were made by Technicolor, which is adapting its cameras to the use of CinemaScope lens.

We are using a conventional single strip 35mm studio camera for "The Robe," fitted with a CinemaScope lens which compresses the wider field of vision onto the 35mm frame. A compensating lens is later placed on the projector and this opens out the picture to the 64-by-25-foot screen which will be employed by most large theatres.

Everyone wonders what differences in angles and acting



VERSATILITY of CinemaScope for both long shot and extreme closeup is illustrated in the scenes above.

CinemaScope will involve. Are closeups out? Will scenes run fifteen minutes without a cut? How does it affect the actors?

Closeups are still possible, as was proved to the thousands of reporters, exhibitors and industry executives who saw the CinemaScope screenings at 20th Century-Fox's Western Avenue Studio in Hollywood and in key city theatre demonstrations. A full-screen head shot of Victor Mature, playing Demetrius in "The Robe," packed such a wallop that I doubt if it will ever be forgotten by anyone who saw it.

Closeups are more dramatic than ever. But they're not as necessary as before, because the screen is so large and intimate that most of the characters will be in the equivalent of closeup anyway, in the sense that their faces will be close enough for minute scrutiny.

Yes, scenes will be longer, but this won't be apparent to most audiences because any well-edited film seems like one long uninterrupted strip of film anyway. Actors will have to memorize more lines and more action, and the timing of scenes will have to be precise, as cutting to other angles will be less frequent and more difficult.

There are some technical disadvantages in photographing with CinemaScope but these, in the end, become advantages.

For instance, we must work with light two or three times as hot as normal. This is because we must light huge areas with arcs out of camera range far from the subject. But the advantage gained is that you get in one scene the running time equivalent to several scenes.

This does not mean that we light indiscriminately. On this broad canvas we can paint with lights, highlighting actors and scenes both in the foreground and the background which we want to dominate. We use a two-inch lens for crowd scenes, bringing everything in closer to the audience. This is the size lens used only for closeups in ordinary film photography.

Another advantage is in causing the action to move, not the camera. No longer do we have to truck after the action. The CinemaScope lens encompasses such large areas that the action can move, in a long shot, a dozen city blocks and still stay in the picture frame.

CinemaScope and the Public

ONE of the most experienced merchandisers of motion pictures, Charles Einfeld, vice-president in charge of advertising and publicity for 20th Century-Fox, supervised the campaign which made CinemaScope known throughout the world. He joined the old Vitagraph company in 1920 and was with First National Pictures. When that firm was acquired by Warner Bros., he became advertising and publicity head of the combined companies. He has been in his present post since 1948.

by Charles Einfeld

CINEMASCOPE was announced early in 1953, the year that marked the fiftieth anniversary of the first motion picture "epic." It took a full half-century to go from "The Great Train Robbery," the 1903 granddaddy of all modern movies, to 1953's wide-screen stereophonic CinemaScope.

If 50 years seems a long time, it might be well to reflect that a good many of the people who started going to the movies in 1903 are still around to keep on going to the movies; they will feel an even greater thrill of discovery when they see "The Robe" than they felt 50 years ago. For the birth and the rebirth of motion pictures have occurred within the adult lifespan of the average American.

Movies move fast. The motion picture has changed more in 50 years than the stage, for example, or music or sculpture have changed in centuries. Painters have not yet figured out a way to improve on Rembrandt; composers have no new inventions to give them the sweep and scope of Beethoven, and they write their music for the very same instruments as he did.

The difference between CinemaScope and the routine talking picture of the past is comparable in impact to the difference between a crystal radio and a high fidelity FM receiver, or between the first refrigerator and the modern freezer.

The impact of CinemaScope on the public actually begins when they enter the theatre, before the show even starts. They see the screen. It is an eye-stopper, an attention-getter, a promise of something spectacularly new and different.

The CinemaScope screen is the widest you have ever seen; it is twice as wide as the conventional screen. It fills the eye of the beholder, and it makes a motion picture literally eye-filling.

It's quite a change for the movie-goer, as sound dramatically as it is from the mechanical or physiological point of view. It is not only easier on the eyes; it is also far closer to what the founding fathers of the drama had in mind for the physical shape of a play.

In thousands of years, nobody has yet managed to top Aeschylus, Sophocles and Euripides, the ancient Greek dramatists who started the world of dramatic make-believe. If Aeschylus and company had been asked to do plays for a screen almost as high as it was wide, they would probably have turned in their quills. There were no roofs at all on their theatres; they just set up a "skene" of oblong proportions and let the audience watch from a nearby hill. It was no mere accident that the classic Greek "skene" and practically every stage up to now has been constructed to emphasize its width. That happens to be the way our eyes see—much more width than height.

Frankly, we who work with CinemaScope feel that this new wide screen is correcting an old if understandable mistake of the movie pioneers. They changed the shape of the screen from the familiar stage proportions. They probably did it accidentally; but they did it, and for more than 50 years our industry just let it go at that.

After Edison, it was commonly accepted that the shape of a picture on the screen was to be different than the shape of a presentation on the stage. During the first 50 years of the movies there were occasional experiments with bigger pictures, but the height increased as much as the width; the shape never changed.

In the same 50 years, other shapes changed. Newspaper advertising, for example, graduated from single columns of variable depth to big multi-columned display advertising. The billboard—shaped, incidentally, much like CinemaScope's screen, except for the curve—became one of the most effective advertising media yet devised.

So the revolutionary change to CinemaScope movies is actually evolution in a big way—long delayed evolution brought into reality in one miraculous overnight switch by a major moviemaker.

CinemaScope and the public share one basic standard. They both require good entertainment. The audience and the process are there, but both go to waste—and the audience is impatient of waste—unless the process is used correctly and dramatically. That is why the first CinemaScope production was given more than eight months from inception to premiere.

Certain entirely new concepts of motion picture marketing and programming are raised by CinemaScope. The question of advertising, for example, brings up a whole new set of values. Newspapers up to now have insisted on a substantial depth for every amusement display advertisement; the result has been to mould most advertisements into an aspect ratio never glaringly different from the screen's itself. This has even been thought by some experts to be a wise psychological approach to the customer.

Similarly, there generally has been a substantial degree of reluctance to utilize perspective in movie display art. It is probably safe to say that movie ads up to now have employed as much false perspective, to heighten a dramatic effect, as they have used true optical image proportions.

Now, it seems to me, all this must change. It must change for the very same reasons that it remained the same through the years. In that long period of time, it matched what was to be seen on the screen. Now, with wider screens and a panoramic illusion of closeness to the scene, the advertising in both shape and visual technique must match the new movie concept.

Newspapers probably will relax their requirements as to the depth of movie advertising space. For their part, motion picture advertising creators face the challenge of conveying the sweep of CinemaScope in eye-catching, eye-filling art. A whole era of movie advertising—and movie production—was built around the closeup of a love scene. The advertising as well as the movies themselves were pegged to the John Gilbert-Greta Garbo clinch, or the later Janet Gaynor-Charles Farrell youthful romantic combine presented by the old Fox Film Company.

Love scenes, it goes without saying, will still be with us. Great romance is just as appealing on a wide screen as on a narrow one; the advantage, despite its size, is with the newer picture, for its stereophonic sound system brings to any scene, however intimate, the same aural reality that the eye perceives. Yes, love scenes will remain—but there will no longer be any need, either in the scene itself or in the ad drawn from it, to cut continually from the back of one head to the back of the other, or to switch every now and then to a re-establishing shot to remind the audience where the action is taking place.

Advertising up to now has been content to spotlight a visual vignette and let words or white-space-plus pick up the effect from there. Greater ingenuity seems likely with CinemaScope.

I should not be surprised to hear that managers, at the beginning, have to persuade patrons to sit in seats on the side, up to now regarded as poor locations because old-type movies appeared distorted unless viewed more or less head on. The fact that CinemaScope, with its curved screen and its wide aspect, gives the viewer in the side seat a perfectly good picture will sooner or later percolate to the knowledge of every ticket buyer, but it will take a while.

I am also, frankly, of the opinion that the public is a single-standard body. I do not believe that they will permanently accept, on an equal long-term basis with CinemaScope, any motion picture in narrower size. I believe that my company's decision to adopt the panoramic screen was based on a sound and extremely significant point. These new movies are unlike old-fashioned movies in every way; it would be wrong even to try to condition the theatre audience to see CinemaScope one day and be content with pictures half the size the next.

Our industry has been built on the continuity of its patronage. We cater to a world-wide audience of hundreds of millions of people, who keep coming to their theatres week in and week out.

We are obligated to provide for these millions of steady customers a continuous flow of product; up until now the product has been all in one single format. No matter who the stars or what the plot, the public knew the picture would be standard photography on a standard screen with standard one-track sound. There was nothing better, so the public was content. But now there is something better.

Those of us who remember the birth of the modern talking picture can recall a period of extreme confusion, when the theatre-goer often didn't know whether he was going to a silent film, a silent with synchronized musical score, a part talkie or a 100 per cent all-talking picture. I would not want to see that kind of confusion repeated—and I doubt that any theatre manager who lived through it would want it repeated.

And so one of the problems of CinemaScope and the public is the problem of orderly transition. This is a problem in every phase of motion picture marketing from the first national advertisement to the last showing of the picture in a subsequent run theatre thousands of miles and an ocean or two away from Hollywood.

From the moment our advertising first presents CinemaScope to the public, there must and will be no interruption in the presentation of CinemaScope films. This is not merely to convince skeptical ticket buyers of the permanence of the change. It is also to insure their continued primary allegiance to the motion picture theatre.

Accidentally but fortuitously, CinemaScope is a truly international product. It is based on the brilliant optical science of a Frenchman, Professor Henri Chretien, and the vision of Spyros P. Skouras, Darryl F. Zanuck and their associates. Mr. Skouras, an unceasing searcher after new ideas for improving entertainment, brought the Chretien idea back to the United States after a characteristically intensive investigation which he conducted personally on the Continent. Mr. Zanuck and our company's technical experts, working at unprecedented speed, brought CinemaScope thereafter into practical reality with the new Miracle Mirror screen and a stereophonic sound system that does for the ears of the audience what the giant screen does for their eyes.

The knowledge and technical advances of many nations went into this latest milestone of entertainment and communications progress. Many other nations will benefit from it, as well.

Many other fields will benefit too. Looking back into the pages of history, it becomes clear that a revolutionary change in one popular art has a profound effect on the other arts of its time.

I believe that part of the impact of CinemaScope will be reflected in the type and format of, for instance, the paintings of the future. Will they be panoramic? Will the canvases themselves possibly even be stretched on curved frames like a CinemaScope screen? I would not be greatly surprised if they were.

More and more we are thinking in terms of width rather than height. We live wide nowadays, preferring the ranch house to the two-flight. Our automobiles are longer and wider and not as high as they used to be.

It would be rash, to say the least, at this stage of the game to venture to predict all the ways in which CinemaScope's impact on the public is apt to be felt. The new scope of the motion picture gives it the ability to capture and reproduce great scenic vistas; perhaps this will inspire a greater interest in the geographical wonders of the world around us. Perhaps the amazing stereophonic sound of CinemaScope will influence the music of tomorrow; some future Beethoven may create new music which "travels" and moves from one side of the auditorium to the other.

At any rate, the name of the CinemaScope process of itself is some indication of what we expect of it. Cinema and scope, the two words combined in the title, are universal words, known to practically every language. CinemaScope represents a great industry in motion, moving toward its greatest times.

It is an exciting thing to be part of this new motion. How much more lies ahead is hard to foretell; but we have come a long, long way into a new era of entertainment.

Every movie-goer and every movie showman will long remember his first meeting with CinemaScope. For us, the second half-century of the modern motion picture is well begun.

CinemaScope in the Theatre

AS technical director of 20th Century-Fox, Earl I. Sponable has been responsible for developing the CinemaScope process from its status as a half-forgotten French invention of a quarter of a century ago to a tool suitable to Hollywood's needs of today. A graduate of Cornell, Mr. Sponable worked from 1916 to 1926 for the Case Research Laboratory, Auburn, N.Y., where early work was done on developing sound-on-film. Since then he has been with Fox.

by Earl I. Sponable

IN THE DEVELOPMENT of CinemaScope there has been the challenging task of increasing the entertainment values of the motion picture through devices effectively applicable to a huge establishment of theatres presenting a wide variety of physical conditions. That was the goal which Mr. Spyros Skouras set for the research department of the 20th Century-Fox Film Corporation when he acquired the anamorphic optical system of Dr. Henri Chretien, upon which CinemaScope is based. The objective from the beginning has thus been a new technique combining instruments of production and exhibition to create an expanded screen performance available to theatres generally, throughout the world.

The CinemaScope picture may occupy an entire stage of the world's largest theatres, filling the full width of the proscenium opening; in small auditoriums without a stage of suitable scale, or in theatres of any size which have no proscenium at all (as encountered among houses of more recent design), the screen can extend across as much of the front wall as desired in order to realize the purpose of visual domination and audience participation for which CinemaScope has been developed. CinemaScope is applicable to every theatre.

Where there is a balcony, the picture must (unless structural changes in the upper level were resorted to) of course be of dimensions that prevent the overhang from obstructing vision from the rear rows of the main floor. This consideration would have bearing on the width by limiting the height, for CinemaScope has an aspect ratio fixed at 2.55-to-1; however, when the screen can be placed well forward on a stage, it can rest on the floor; further, where it is located across the front of the auditorium, the bottom edge can be as low as present experience dictates as acceptable.

Being curved, the screen requires width of space somewhat less than the actual length of arc of the picture. This curvature varies from theatre to theatre, being determined basically by the projection throw—that is, the distance from projectors to the center of the theatre's screen becomes the radius of curvature of the screen.

It may be pointed out that the degree of curvature is not really critical. Adjustments can well be made where extraordinary conditions suggest them, as might be the case should a theatre have a very short throw relative to the width of the auditorium; but it is undesirable that an auditorium of a commercial theatre should have a radius of curvature of less than 75% of the projection throw, and that minimum would still provide for acceptable definition at the sides of the picture. If the screen is too deeply curved, i.e., if the radius is short, then the geometric distortion of the projected image becomes objectionable.

The reflecting surface of the screen is metallic, making it suitable for stereoscopy employing polarized light; and the material is embossed in a system of what are essentially tiny mirrors; the lateral dimensions and shape of these mirrors control the lateral, or horizontal spread of the light reflected into the theatre from the projector, while, similarly, the vertical dimensions and shape of these elements control the vertical distribution (of the light in the theatre). Two types of patterns are available: one intended for low angle projection, and one for those theatres having projection of roughly 15° degrees or more. These patterns compensate for the projection angle as far as uniformity of light distribution is concerned; they obviously have no effect on the "keystone" problems.

The structure on which the screen is mounted is erected in the proper curvature by assembling prefabricated units or by construction on the job, as conditions or preferences suggest. Designs have been worked out with structural engineers to develop efficient structures; however, it is contemplated that the frames for CinemaScope screens will be purchased from fabricators or theatre supply dealers. It is also expected that, in some instances, exhibitors will elect to have the frame made locally—and it is practicable to make it of wood, if fire laws permit.

Since CinemaScope sound is stereophonic, design of the screen structure must allow for placement of three horn systems, one at the center, and one at each side, with the three so spaced as to "cover" an equal area of the picture, i.e., one in the center, and the others spaced on each side at a distance of one-third the screen width from the center.

Not only the speakers, but all other components of the stereophonic sound system and the projection apparatus, including those initiated by CinemaScope, are items for procurement from theatre equipment manufacturers and dealers. Beside the amplification and related equipment necessary for three channels of sound from the screen, these items include (1) a magnetic soundhead for each projector, mounted between the projector head and the *upper* magazine (leaving the photosoundhead intact for use as needed); (2) intermittent movement, drive, and all other sprocket wheels with narrower teeth (perforations are reduced to 78 mils to provide space for three screen sound tracks and one control, or effects, track on the picture film); and (3) an anamorphic lens for each projector.

CinemaScope lenses are readily removed from their position in front of the regular objective lens for projection of films photographed in the normal way without a CinemaScope attachment on the camera. As we have noted, the photo-soundhead remains available for reproduction of conventional tracks. And, being different from standard sprocket wheels only in the width of the teeth, the sprocket installations called for by CinemaScope prints leave projectors as capable as they were to handle film with standard perforations.

The screen recommended for the full exploitation of CinemaScope—it is believed that the picture should be as large as the auditorium will permit—is designed to be suitable for all purposes. By simply changing the masking, normal—or old style—pictures can be projected, and the screen surface produces practically no depolarization so that stereo (or 3-D) pictures using polaroid glasses, are viewed with a minimum of cross contamination of left and right eye images. Because of its peculiar nature, the screen also tends to increase the visual contrast of an image, and lends an added brightness and sparkle to color pictures. Direct room light, reaching the screen in a direction to be reflected to the viewer, must of course be kept at a minimum.

The CinemaScope projection attachment acts to double the width of any picture produced by the projection lens with which it is used, without affecting the height. If in a certain theatre using a 4″ lens for example, we obtained a normal picture 20 ft. wide from a present standard frame, when we add the CinemaScope attachment the picture becomes 40 ft. wide (the height still stays 15 ft.). However, if at the same time we replace the standard film (frame size .600 x .825) with CinemaScope film (frame size .715 x .912) then the projected pictures will be both higher and wider than with the standard film; in other words, with the same lens, we now have a picture 19′ 10″ x 45′ 6″. We can, of course, bring the height back down to 15 ft., if the theatre size dictates this procedure, by changing to a longer focal length lens, in which case the width would be 15′ x 2.55 or 38′ 3″.

It will be apparent from this that the increased area on the screen, which is illuminated through a definite area of film, is exactly twice the area without the CinemaScope attachment, the rest of the increased area on the screen being provided by an increase in frame size (and being illuminated by light which in present standard pictures does not get through the smaller present aperture.) Since we have doubled the area of the screen, for each corresponding area of film we must somehow compensate for the equivalent loss of picture brightness. (The absorption loss in the coated lenses of the CinemaScope attachment is only a few per cent and is not significant.) This brightness loss may theoretically be made up in two ways: (1) by increasing the light from the arc; (2) by increasing the efficiency of the screen. The CinemaScope process uses the latter method. The screen, by its controlled reflection, provides a picture somewhat more than twice as bright as you would get on a plain white screen substantially throughout the useful seating area of the theatre. To boil this all down, the CinemaScope attachment spreads the light over twice the area, and reduces the brightness to one half; the use of the Miracle Mirror Screen puts the brightness back exactly where it was before.

Of course, there will be some theatres having insufficient light at present that will desire to increase the light from the arc, when installing the larger picture; and some theatres may (some already have) decide to increase the overall picture still beyond the one produced with their present lenses. This, too, will require more light.

It is to be noted that a curved screen of any type introduces geometric distortion—horizontal lines, like the horizon, or water, appear curved. This factor indicates that the curvature should not be too great, as was pointed out in an earlier paragraph. Increasing the width of the screen increases the effect of keystoning, and this effect should be reduced by tilting the screen backward. Five or six degrees tilt is very helpful in cases of steep projection angles; there is no hard and fast limit, but more than this complicates the masking problem, and introduces other undesirable viewing distortions. Since the aim of CinemaScope is to fill substantially all of the useful visual angle, the use of illuminated surrounds in such a case should be the subject of very careful study. Masking with dark absorptive material in the usual manner, with the top edge of the bottom mask parallel to the floor, and the other masks squared up to the bottom, produces a pleasing picture, and is the preferred method.

Enlargement of the picture to sizes capable of visual domination and of an effect of audience participation—at least twice the width of the picture previously presented—inevitably raises the question of seat loss in forward rows. It is not believed that most CinemaScope installations in which the screen can be placed on the stage need cause any sacrifice of seating. There is currently a standard minimum viewing distance (Society of Motion Picture Engineers, accepted by the American Standards Association) which calls for the first row to be at least 0.85 times the width of the picture, and some authorities recommend that this distance fully equal the width. This standard was promulgated, however, long after the motion picture had enjoyed many years of successful exhibition with front rows much closer to the screen than this standard allows.

But however much the factor of 0.85W may well apply to the motion picture performance as we have known it, the new "wide-screen" technique has introduced new psychological values that affect the forms of presentation. It is the purpose of CinemaScope to give the performance greatest possible intimacy, the quality of "presence" in place of the remoteness characteristic of traditional movies; and to exploit fully those scenes and subjects in which an audience can enjoy a sense of participation. Many people may find these values actually enhanced when seated almost *within* the panorama afforded by this new kind of motion picture performance.

OTHER TECHNIQUES

The Anamorphoser Story

BORN in a distinguished military family, H. Sidney Newcomer turned to the sciences. After post-graduate work in mathematics and physics at the University of Wisconsin he went to medical school at Johns-Hopkins. Graduate work in medicine and the optical sciences was carried on for several years in Europe. In the period from 1928 to 1932 he designed and built a number of anamorphosing optical systems. His important contributions in the field of medicine range over a wide field.

by H. Sidney Newcomer, M.D.

DO not reach for your dictionary to find out whether "anamorphoser" is vegetable or mineral. You will not find it there. Anamorphoser is the coined name used to apply to a cylindrical lens system which compresses a picture horizontally as it is taken and expands it in the same direction in projection.

The anamorphoser long antedates the motion picture era. It could be anticipated that the motion picture industry would be interested in the possibilities the anamorphoser presents. Two decades ago the industry decided to explore the techniques of wide screen pictures and the anamorphoser was seriously considered as the best method of achieving quality results. Then the depression came along and the industry discontinued all expenditures for experimentation in wide screen methods. After twenty years interest has been revived in this project and in 1953 public acclaim has been given to CinemaScope, the most completely developed and thoroughly engineered anamorphoser.

The anamorphoser serves the purpose of squeezing a wide set or picture onto standard film, thus increasing the width without changing the height. When projected the compressed picture is re-expanded by a reversed process to cover a horizontally greatly enlarged screen. In using the anamorphoser one employs standard film and its use is the only means by which one can compress a wider image onto such a film and then expand it to cover a greater than normal screen area without accentuating grain.

The cylindrical anamorphoser is not a recent development. Ernest Abbe, founder of the Zeiss works in Germany, long ago described the basic types. Through P. Rudolph, he set forth in a British patent No. 8512, published in 1898, the fundamental concept in the words:

> "This invention has for its object to solve the following problem: to obtain by means of a lens system, such an image of a plane object, that all the points of the object be reproduced in that image by corresponding sharply defined points (the pencils of rays from the points of the object being once more homocentrically united in the plane of the image), the linear enlargements, however, taken in two diameters of the plane of the image, at right angles to each other, being unequal, so that the relation which the object and image bear to each other must be described, not as similarity but as affinity."

Various possible means of doing this are shown in the text and figures of Rudolph's patent on an anamorphotic lens system. Examples of this type of optics as applied to motion picture work are described in patents granted to many different individuals in the decade before Professor Henri Chretien and I began working in this field. None of them did exactly what we did and none of them described in detail an effective optical system capable of rendering quality pictures. Hence there existed the possibility of our securing patents for more workable systems.

A patent granted to Ernest Zollinger in 1912 showed a motion picture anamorphosed for a different purpose than wide screen in that he compressed the picture vertically to half size in order to permit the use of a two-color additive process, employing only one frame per color pair of compressed pictures, later to be expanded and superimposed.

The Parker patents issued in 1920 similarly concerned motion pictures in which compression was used to permit multiplication of the number of pictures within a frame for the purpose of additive color photography. However, the Parker patents went somewhat further in that they actually disclosed in simple form an anamorphosing optical system to be used to secure such compression. These patents were so explicit in this respect that they constituted, until the time of their expiration in the late 1930s, an impediment to the use by others of the anamorphoser in wide screen work.

A Phillips patent issued in 1919 gave additional details of such systems and a Ford patent granted in 1930 contained further substantial disclosures.

However, all of the foregoing patents failed to describe workable optical systems for the actual production of such pictures or to go beyond the Rudolph patent in setting forth refinements of such optical systems.

Chretien may or may not have been aware of these obscure developments, and may not have known of the Ford and Parker work which preceded him in the motion picture field. However, at a meeting of the French Academy of Sciences on May 30, 1927, Henri Chretien, introduced by M. Louis Lumiere, presented a paper on a method of panoramic cinema photography with standard film. At this meeting he outlined the use of a new system employing two cylindrical lenses with parallel generatrices. It would appear from this paper that Chretien at the time made a demonstration of the described apparatus and greatly impressed the audience with its possibilities.

During the course of my optical studies in Europe and while in Paris I became interested in the anamorphoser and discussed it at great length with Professor Chretien. I hoped to persuade him to complete his work on a perfected anamorphoser system such as might compete by virtue of its optical qualities with the wide film developments then getting under way in the United States. At this time, 1928, it might have been possible to convince American producers of the desirability of adopting such a system in preference to wide film. No timely arrangements were completed, however, which would have made it possible to proceed in the United States.

After I returned to America I proceeded to design and construct a system of my own. The better part of a year passed before this could be accomplished and my first patent was filed in March, 1929—a second followed in January, 1930. At the same time developmental work was carried on in the actual construction of a cylindrical system which would have surfaces of a quality comparable to those employed in the construction of good spherical optical systems. That the problem was extremely difficult is evidenced by positive passages to be found in statements made by the greatest craftsmen in the optical arts to the effect that cylindrical lens surfaces of good optical quality cannot be made. This unenlightened attitude even permeated to the Patent Office, where patents were all but refused me on the ground that the systems disclosed were unworkable because they could not be constructed.

This conception was so prevalent that in a record of a meeting of the Royal Photographic Society in London in 1932, in the course of a symposium on wide screen photography, the following appears:

> "There were in fact, Mr. Lee said, very serious objections. The designing of these systems was exceedingly laborious, and the manufacture of deforming systems with cylindrical lenses far more difficult than of optical systems with spherical surfaces. Moreover the anamorphosers necessarily affected the image adversely; they were always merely attachments and, adding at least eight glass to air surfaces which scatter a third of the light, they involved increased exposures. Again since they entailed increased magnification in one direction, the factor of image grain was accentuated. The same objections applied to the use of these devices, as had been suggested, for wide angle views on 16mm film and, as the speaker urged, the use of ordinary wide angle lenses was preferable. The anamorphoser did not give any advantage in resolution, and owing to its inferior correction was probably disadvantageous in this respect. For these reasons the speaker adopted the

> view that the advantage of anamorphosers in cinematography was illusory, and nothing further could be anticipated from them."

These views stimulated my own efforts to solve the problem. Finally toward the end of 1929 I managed to overcome the difficulties involved in the design and construction of a cylindrical lens which would give a highly satisfactory result.

An expansion ratio of 1 to 1½ so as to produce a picture 1 x 2 in size seemed to me at that time to be the most suitable. I therefore concentrated on the design and manufacture of such a system. The lenses which Professor Chretien subsequently demonstrated in New York in the early 1930s, as with his early Paris demonstration, provided a 1 to 2 expansion ratio, rendering a picture 1 to 2.55 in its proportions which I feel makes the most effective application of anamorphic systems. This ratio has since been adopted in CinemaScope.

Careful scientific studies of the properties of lenses used in motion picture cameras and projectors have shown that the screen picture definition enjoyed with standard 35mm film cannot be attained on substantially larger screens if equal lens apertures are used. It is not possible to take, nor feasible to project, wide screen pictures either from standard or from wide film without a reduction of image quality unless an anamorphoser is used. When the anamorphoser is used the wide screen picture is of a quality comparable to that of a standard picture.

The anamorphoser has another advantage. It increases the depth of focus, and hence the general sharpness of the images over and above that obtained in the usual way for ordinary pictures. This is true because a cylindrical anamorphosing system magnifying, for instance, fifty per cent in one meridian, increases the depth of focus in that meridian one hundred per cent. When the anamorphoser is focused, the interaction of the two elements of the anamorphoser on light coming from points nearer and farther away is such as to bring together the corresponding camera lens images and bring them nearer the image plane for the same mean focus. The amount they are moved toward this plane is exactly one-half the focusing difference of the camera lens for these points. Although this increased sharpness exists in one meridian only, because of the vertical asymmetry of the refracting system of the eye, the sharpness simulates a two-dimensional one and at the same time brings in certain accessory qualities to the picture which contribute to a stereoscopic impression.

Even without these advantages the use of the anamorphoser would be recommended for its simplicity. In the many processes to which negative and positive film are subjected from the taking of the picture in the studio to its projection on the theatre screen, the anamorphoser is used only twice; namely—at the beginning when it is placed in front of the regular camera lens and at the end when it is placed in front of the projection lens in the projection booth. In all of the many stages of processing and handling, the film is treated as standard 35mm film and the tremendous expense involved in special equipment for wide film is avoided.

Wide screen pictures produced by anamorphosers on standard film came very near to adoption by the motion picture industry over two decades ago. Early in 1930 pictures made with lenses of my design were demonstrated in New York before trade audiences. However, the deepening of the depression finally brought to an end further development on wide screen projects.

Although the use of the anamorphoser was for the moment abandoned by the motion picture industry, there were many other fields in which the anamorphoser could be used to advantage. Throughout most of the 1930s I continued to work in the anamorphoser field, filing many patents for the improvement and modification of optical systems applicable to motion picture work in its various phases as well as to other fields quite foreign to this industry.

The application of the anamorphoser will open up, in my view, the way to larger and more attractive pictures—in both 3-D and wide screen—that will augment the excellent standards of pictorial quality for which the entertainment motion picture is famous and which contribute so much to its dramatic effectiveness and the satisfaction of the public.

There Is No Substitute for Creative Talent

AN important share of the credit for Universal Pictures' strong financial position goes to William Goetz, in charge of production from 1946. The studio under his direction has established a commendable record in making profitable pictures. Mr. Goetz' whole career has been as a production executive at various major studios in Hollywood. Universal has recommended to exhibitors a wide screen with an aspect ratio of 1.85 to 1.

by William Goetz

THE IMPACT OF 3-D and Wide-Screen publicity has created a stimulus to the motion picture not equaled since the advent of sound.

However, like any technological transition, this particular one is fraught with many complications and perplexities.

While all the studios are making, or are in the process of making, 3-D pictures, it must be kept in mind that thousands of theatres throughout this country and the world are not as yet equipped to take full advantage of these technical advances.

With the generation of all this excitement, our studio some months ago realized that our major responsibility was to assure theatre owners that we would be able to supply them with a constant flow of pictures so that, during the period of transition they could expect the normal supply from Universal.

Our studio, therefore, has not curtailed its production program and, as a matter of fact, during the fiscal year 1952-1953 will release the same number of pictures as we did in the year before.

The simple point is, even though we already have two pictures in 3-D, we feel that the inherent entertainment value of the so-called "flat" picture is still sufficiently important to maintain a high box office level.

But our studio, realizing the confusion that has resulted from a lack of unified planning of equipment, decided that it would be an important service to exhibitors if an all-purpose screen were developed. As a result of this conviction such a screen has been developed by our studio technicians.

With a metallic surface, as required by 3-D, the screen has a light-reflectance factor four times that of a diffusive screen. It is slightly curved; for example, to present a picture 50 feet wide (which, at a 2-to-1 aspect ratio, would be 25 feet high), the curvature would be calculated on a radius of approximately 90 feet (depending on conditions in the theatre), which would curve the screen to a depth of about 3½ feet.

For projection of a picture of these proportions the aperture plate is cut to block off enough of the bottom and the top of the frame to give the necessary reduction of height. Standard projection lenses are used in a focal length to give a picture of the desired width according to the projection throw in each case.

Thus, we believe, we have achieved a compatibility in our screen that will enable us to proceed with our complete program of pictures and, at the same time, will enable exhibitors to install the screen at a most reasonable cost, along with stereophonic sound. The screen will accommodate both 2-D and 3-D pictures, and an exhibitor will have a sufficient supply of 2-D pictures from our studio in the event that he does not want to invest in new equipment.

To simplify the point, the exhibitor may expect to receive from Universal the usual number of pictures without any apprehension arising from technical difficulties. On the other hand, if he installs our large screen, our regular pictures will receive the advantage of augmented size.

This system also enables all creative talent to think in genuine cinematic terms so that writers, directors and even actors will not have the psychological hazard, for the time being, of dealing with a new medium.

Our studio definitely believes that the ultimate good health of our business will depend upon the content of the picture. We know from experience that the public quickly absorbs technical progress. We also know that what finally counts is the amount of entertainment contained in any given picture.

It is in recognition of this that I can comment facetiously that we still have to cope with the fourth dimension of the screen, and that is, of course, the story and the talent behind the story.

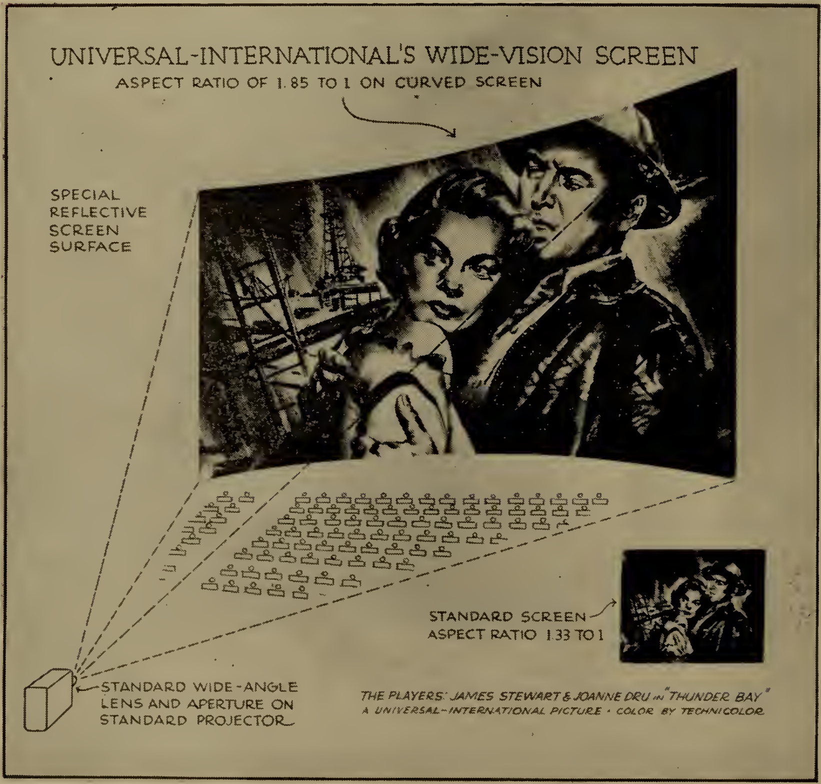

UNIVERSAL-INTERNATIONAL'S WIDE-VISION SCREEN
ASPECT RATIO OF 1.85 TO 1 ON CURVED SCREEN
SPECIAL REFLECTIVE SCREEN SURFACE
STANDARD SCREEN ASPECT RATIO 1.33 TO 1
STANDARD WIDE-ANGLE LENS AND APERTURE ON STANDARD PROJECTOR
THE PLAYERS: JAMES STEWART & JOANNE DRU IN "THUNDER BAY"
A UNIVERSAL-INTERNATIONAL PICTURE · COLOR BY TECHNICOLOR

ILLUSTRATION of the 1.85 to 1 screen aspect ratio recommended by Universal-International. The system involves the use of a wide-angle lens on the projector, alterations in the projector aperture plate and installation of a wide screen.

There is no doubt that 3-D and Wide-Screen will accommodate certain subject matter which, prior to these devices, might have become commonplace and stereotyped. But in the entertainment field, unless there is constant enrichment of the creative forces, everything ultimately becomes commonplace.

Although we are aware of the fact that these technical improvements are not in themselves a panacea for our business, we do believe that they will serve as an impetus and an inspiration to our creative craftsmen.

But, in the final analysis, the play's the thing.

Why New Aspect Ratios?

FOLLOWING his graduation from the University of Wisconsin George Schutz was a newspaper reporter. Then he was with Red Book Magazine three years before joining the editorial staff of Quigley Publishing Company in 1927. Since 1931 he has been editor of Better Theatres and has written extensively on all phases of the physical theatre, its equipment and maintenance. Mr. Schutz has been a pioneer campaigner for the "Big Picture."

by George Schutz

THE idea that has come to be propagated through channels of production and distribution under the term "wide-screen," is fundamentally a concept of theatre design. An incorrigible pessimist could make much of that fact, pointing to the billions of dollars of real estate already devoted to the exhibition of motion pictures, with a little chance of replacement. Such a dismal appraisal of the idea is quite unacceptable, however, to people who have money invested in these theatres. Besides, the "moving picture" was itself once a gimmick.

Recognition of the architectural function in the application of so-called "wide-screen" nevertheless can be of practical value, if only as a measure of the ultimate job to be done if the idea is to be carried toward its full possibilities. There is only so much to be attained through mere dimensions of the screen itself. A great part of the remainder lies in how those dimensions are related to the size and forms and surfaces of the auditorium. The rest consists in the way the enlarged performance area is used creatively, cinematographically.

In that contemplation of the objectives, the "Big Picture" is new. Historical reflections that have been evoked by "wide-screen" since that name for it came along, have pointed out instances of enormous motion picture images in the distant past, of "Grandeur" films, and so on. They were relatively large in square footage. What has been proposed since goes beyond the reaches of a foot-rule. Physical magnitude is a critical feature of the idea; however, the function of scale is not a matter of screen dimensions alone if "wide-screen" is to be a technique rather than a stunt of sheer magnification.

Before the industry added the term "wide-screen" to its lingo, before "Cinerama" stirred up its interest in an expanded screen image, enlargement of the picture was urged as part of a scheme to give a motion picture performance in a theatre a power beyond challenge from any comparable medium elsewhere to produce an experience of reality. It had not lost its uniqueness in that respect —but television was rubbing off some of it to mix with its chief distinction, a maximum of convenience. Whether theatres should enlarge their screen images had long been argued. Advancement in projection light sources and optical systems had made bigger pictures practicable by the time the obscure little television image suggested them as a ready, if dubious, competitive device, and there was a trend toward larger pictures through most of the latter '40s. Being proposed, however, was a picture that would *dominate the field of vision,* achieving this partly by a much greater increase in size than had yet been considered in practice, and partly by theatre design, specifically in the forward third of the auditorium and particularly in the immediate vicinity of the screen.

The method called basically for elimination of architectural forms and decorative doodads, vehemently including sources of light, which invaded perception of the screen image. It further specified that the picture be free of the time-honored black masking and related borders which made it appear remote and even smaller than it was. By these devices, and by neutralization of wall and ceiling surfaces within the range of effective audience vision, the projected picture would be free "to seize and hold the mind," and the faculties of perception would thus be helped "to construct a convincing mental experience of the pictorial material."

In this conception, a picture of dominant scale *visually* would be attained with considerable latitude in determining the physical dimensions of the picture itself. The wide variation in structural conditions of theatres advises flexibility in sizing the picture without sacrifice of visual domination. Available sightlines and viewing angles are other critical factors. But regardless of those considerations, the scale of the screen image changes in any auditorium as the distance of the spectator from it increases. Psychologically effective domination of the visual field is by no means assured all, or even the greater part, of an audience by mere extension of screen width to the practicable limits. Actually, the auditorium should be designed, it was held, so as to avoid a sense of scale!

While the conditions for the kind of presentation thus contemplated could best be realized in designing a theatre from scratch, they were not regarded as beyond the reach of existing theatres. Indeed, a study of typical auditoriums indicated that they could be produced, to varying degree, in most theatres.

Until recently extension of the picture dimensions was thought of in relatively modest terms—widths of 30 to 40 feet even for fairly large theatres, compared with 50 to 65 feet, or more, in the calculations of "wide-screen systems." Such enlargement was nevertheless enough to make the 4-to-3 (1.33-to-1) ratio of the standard 35mm film frame loom as a problem in many cases. Since the eyes see more laterally than they do vertically in a ratio much greater than 4-to-3 (almost 3-to-1 actually, though effectively in proportions closer to 1.5-to-1), it was observed that greater lateral than vertical expansion not only would facilitate installations, but would produce an image more in accordance with the aspect of natural vision.

With pictures produced in the 4-to-3 proportions, not much could be gained horizontally without risking loss of heads and limbs in many a scene—unless the producers could be persuaded to introduce camera hairlines vertically delimiting the area of critical material in some feasible amount. At the same time, it was suggested (rather furtively) that cinematography might also use wide-angle lenses to a greater extent.

These changes in studio methods have become practice, or are contemplated among major American producers, constituting the basis of "wide-screen" technique, as so far developed, except for the compression-expansion process of CinemaScope.

Screens proposed for enlargement of the image in new proportions are exemplified in the specifications submitted by Paramount Pictures. Although retaining the standard film frame of 0.868 x 0.631-inch, camera hairlines are set for a projector aperture reducing the height of the picture by approximately 20% (cutting off 10% of the image at the bottom, and 10% at the top), to produce a screen image in a ratio of about 5-to-3 (1.66-to-1). Paramount screen specifications call for a slight curvature, varying according to auditorium dimensions and projection throw. For auditoriums relatively wide, the radius of curvature recommended

***SCREEN** as conceived by Paramount to represent specifications promulgated by that producer for a picture in the aspect ratio of 1.66 to 1. It is shown with a luminous surround applying the Schlanger-Hoffberg principles embodied in the RCA "Synchro-Screen." The figure indicates the relative size of this screen, which is scaled for a picture 33 feet, 4 inches wide.*

is equal to the throw (assuming projectors are no farther back than the last row of seats); for auditoriums of less relative width, a radius less than the throw may be best, but in no case should it be less than 75% of that distance.

Paramount also suggests the use of a luminous surround and has provided specifications for one applying the Schlanger-Hoffberg principles of "synchronized" light as embodied in the RCA "Synchro-Screen." With the screen itself of metallic type for optimum reflectance and especially for projection of 3-D pictures, the surround must be of diffusive material, forming wings and a cornice of prescribed curvature, and a sloping base.

Other ratios than 1.66-to-1 have been suggested for this aperture-controlled method of applying "wide-screen" technique. Universal-International, which has also developed screen specifications, has in fact announced the use of 1.85-to-1. None of the others in this category are greater than 2-to-1, however, so that by masking, or constructing a luminous surround that can be moved for adjustment to picture dimensions, widths and heights can be varied to accommodate different aspect ratios, including the traditional 4-to-3.

Thus, in addition to Cinerama and CinemaScope, the idea of the "Big Picture" has been put into effect—hurriedly, incompletely, but with sufficient commitment to some of its fundamental components as to allow no turning back to the remote little performance away off there in the darkness. This much has placed the art in a position to produce greater impact and conviction at once, and to grow in that direction, with the help of theatre design, largely through modernization, and with efforts to learn how this greater canvas may be used to even greater advantage.

Quigley Publications

Motion Picture and Television ALMANAC
(annually in September)

Fame (annually in February)

Richardson's Blue Book of Projection

●

Motion Picture Herald (weekly)

Better Theatres (monthly)

Motion Picture Daily

The Authors

MORT BLUMENSTOCK	vice-president, Warner Bros.
JAMES BRIGHAM	theatre engineer, Natural Vision
CHARLES EINFELD	vice-president, 20th Century-Fox
LYNN FARNOL	publicist
WILLIAM GOETZ	in charge of prod., Universal Pictures
DR. ALFRED N. GOLDSMITH	consulting engineer
LORIN D. GRIGNON	sound engineer, 20th Century-Fox
MILTON L. GUNZBURG	president, Natural Vision Corp.
DR. HERBERT T. KALMUS	president, Technicolor, Inc.
HENRY KOSTER	director
JEAN NEGULESCO	director
H. SIDNEY NEWCOMER, M.D.	optical engineer
JOHN A. NORLING	president, Loucks & Norling Studios
MARTIN QUIGLEY, JR.	editor, Motion Picture Herald
FLOYD A. RAMSDELL	Worcester Film Corp.
HAZARD E. REEVES	president, Cinerama, Inc.
WILLIAM H. RYAN	engineer, Polaroid Corporation
GEORGE SCHUTZ	editor, Better Theatres
LEON SHAMROY, A.S.C.	cinematographer
SPYROS P. SKOURAS	president, 20th Century-Fox
PETE SMITH	producer and commentator, MGM
EARL I. SPONABLE	technical director, 20th Century-Fox
LOWELL THOMAS	president, Cinerama Productions
RALPH WALKER	architect
FRED WALLER	chairman of board, Cinerama, Inc.
JACK L. WARNER	vice-president, Warner Bros. Pictures
FRANK WEBER	3-D engineer, Holland
DARRYL F. ZANUCK	vice-president, 20th Century-Fox